SYSTEM

OF

MINERALOGY.

A

SYSTEM

OF

MINERALOGY

IN WHICH

MINERALS ARE ARRANGED ACCORDING TO THE NATURAL HISTORY METHOD.

BY

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THIRD EDITION, ENLARGED AND IMPROVED.

VOL. III.

EDINBURGH:

PRINTED FOR ARCHIBALD CONSTABLE & CO. EDINBURGH; AND HURST, ROBINSON & CO. CHEAPSIDE, LONDON.

1820.

P. Neill, Printer.

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MINERAL

MINERAL SYSTEM.

CLASS II.

SALINE MINERALS.

ORDER I.—*FOSSIL SALTS.*

GENUS I.—ROCK-SALT.

Steinsalz, *Werner & Mohs.*

THIS Genus contains one Species, viz. Hexahedral Rock-Salt.

1. Hexahedral Rock-Salt.

Hexaedrisches Steinsalz, *Mohs.*

This Species is divided into two Subspecies, viz. Rock-Salt and Lake-Salt.

First Subspecies.

Rock-Salt.

Steinsalz, *Werner.*

This Subspecies is divided into two kinds, viz. Foliated Rock-Salt and Fibrous Rock-Salt.

First Kind.

Foliated Rock-Salt.

Blättriches Steinsalz, *Werner.*

Sal, *Plin.* Hist. Nat. xxxi. 7. s. 39 (in part).—Muria fossilis pura; Sal gemmæ, *Wall. t.* ii. p. 53.—Sel marin et Sel gemme, *Romé de Lisle,* t. i. p. 374.—Blättriches Steinsalz, *Wern.* Pabst. b. i. s. 361.—Lamellar Sal Gem, *Kirw.* vol. ii. p. 32.—Blättriches Steinsalz, *Estner,* b. iii. s. 63. *Id. Emm.* b. i. s. 19. —Soude muriatée cristallisée, et Soude muriatée amorphe, *Haüy,* t. ii. p. 356. 365.—Le Sel Gem lamelleux, *Broch.* t. ii. p. 21.—Blättriches Steinsalz, *Reuss,* b. iii. s. 30. *Id. Leonhard,* Tabel. s. 44. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 121.—Soude muriatée laminaire, *Haüy,* Tabl. p. 20.—Blättriches Steinsalz, *Lenz.* b. ii. s. 975. *Id. Hoff.* b. iii. s. 223. *Haus.* b. iii. s. 844.—Common Salt, *Aikin,* p. 251.

External Characters.

Its most common colours are white and grey. Of white, it occurs greyish, yellowish, and milk-white; but it seldom approaches to snow-white. Of grey, ash, smoke, and pearl grey. From pearl-grey it passes, though rarely, into flesh, blood, and brick red. Still seldomer do we observe

serve the white varieties marked with Berlin, azure, violet, or lavender blue spots or patches.

It is said also to occur ochre-yellow, wine-yellow, and emerald-green.

It occurs massive, disseminated, in minute veins, in crusts, plates, and stalactitic; also in distinct concretions, which are large, coarse, small, and fine angulo-granular, and these sometimes incline to prismatic *.

It occurs crystallized in cubes. Sometimes the cubes appear as *thick rectangular four-sided tables*, owing to two opposite lateral planes becoming very large in comparison of the others. In other crystals, the figure is that of a *rectangular four-sided prism*, which is produced by two opposite planes of the cube becoming smaller than the others.

On the fresh fracture it is shining or splendent, and the lustre is resinous.

It has a threefold rectangular cleavage, the folia parallel with the planes of the cube.

The fracture is conchoidal.

The fragments are cubic.

In general it is strongly translucent, sometimes semi-transparent and transparent.

It is as hard as gypsum, or even harder, but not so hard as calcareous-spar.

It feels rather greasy.

It is rather brittle, and easily frangible.

It has a saline taste.

Specific gravity, 2.143, 2.2, *Hassenfratz.*—2.1, 2.2, *Mohs.*

* Some authors describe rock-salt in globular and columnar concretions

Second Kind.

Fibrous Rock-Salt.

Fasriges Steinsalz, *Werner.*

Fariges Steinsalz, *Wern.* Pabst. b. ii. s. 363.—Fibrous Sal Gem, *Kirw.* vol. ii. p. 25.—Fasriges Steinsalz, *Estner,* b. iii. s. 71. *Id. Emm.* b. ii. s. 23.—Le Sel Gem fibreuse, *Broch.* t. ii. p. 25. Soude muriatée fibreuse, *Haüy,* t. ii. p. 356. 365.—Fasriges Steinsalz, *Reuss,* b. iii. s. 27. *Id. Leonhard,* Tabel. s. 45. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 121.—Soude muriatée fibreuse-conjointe, *Haüy,* Tabl. p. 20.—Fasriges Steinsalz, *Lenz,* b. ii. s. 979. *Id. Haus.* Handb. b. iii. s. 844. *Id. Hoff.* b. iii. s. 229.—Fibrous Common Salt, *Aikin,* p. 252.

External Characters.

Its colours are greyish, yellowish and snow white; from these it passes into ash and smoke grey; more rarely it is marked with stripes of flesh red, violet, sky, and Berlin blue.

It occurs massive, and dentiform; also in distinct concretions, which are coarse and fine, and straight and curved fibrous.

Internally it is shining and glistening, and the lustre is resinous.

The fragments are splintery.

It is strongly translucent, verging on semi-transparent.

In other characters it resembles the preceding kind.

Chemical Characters.

It decrepitates briskly when exposed to the action of the blowpipe, or when laid on burning coals.

Constituent

Constituent Parts.

* Cheshire Rock-Salt.		
Muriate of Soda,	-	$983\frac{1}{4}$
Sulphate of Lime,	-	$6\frac{1}{2}$
Muriate of Magnesia,	-	$0\frac{5}{16}$
Muriate of Lime,	-	$0\frac{1}{16}$
Insoluble matter,	-	10
		1000.0

Henry, in Philosophical Transactions for 1810, part i. p. 97.

Geognostic Situation.

It is sometimes found in transition gypsum in the transition-slate of the Allee Blanche, and between grey-wacke and black transition limestone near Bex, below the Dent de Chamossaire; in alpine limestone, at Hall in the Tyrol; but the greatest formation is that in muriatiferous clay, in which the salt occurs, either disseminated, or in beds, alternating with the clay, or in vast irregular masses included in it. In this formation, the salt is occasionally associated with thin layers of anhydrite, stinkstone, limestone, and sandstone. Humboldt mentions a formation of rock-salt in muriatiferous clay, lying on a very new sandstone, at Punta Araya in America *; and small quantities of it occur in the flœtz gypsum in the Segeberg, near Kiel in Holstein.

Geographic

* Humboldt's Personal Narrative, vol. ii. p. 269.

Geographic Situation.

Europe.—The principal deposite of salt in this island is that in Cheshire, where there are several beds that vary in thickness from four feet to upwards of one hundred and thirty feet, and alternate with clay and marl, which contain compact, foliated, granular, and radiated gypsum. Rock-salt also occurs at Droitwich in Worcestershire.

In the north of Germany, rocks of the salt formation and salt springs occur,—an evidence of the existence of salt beds, as all salt springs issue from salt beds, or rocks richly impregnated with salt; but no salt-beds appear at the surface until we come to the Circle of Austria, and the neighbouring countries. The range of salt beds commences at Hall in the Tyrol *, passes through Reichenthal in Bavaria, continues to Hallein in Salzburg, Hallstadt, Ischel, and Ebensee in Austria, and terminates at Aussee in Stiria. The further continuation of the salt deposition is found at a considerable distance, that is, in Hungary, at Marmoros, Rhona, Szek, and Speries: then again in the great inclosed circular valley of Transylvania; from thence it extends through Wallachia, Moldavia, Buckovina, Gallicia, to Upper Silesia.

The salt repository of Marmoros is well known. In Transylvania, which is a vast circular valley, having its bottom covered with salt, there are many extensive salt-works: in Moldavia there are also numerous salt-mines; and, what is worthy of remark, the rock-salt itself there forms

* At Sulzbach, on the Necker, in Suabia, there is a great bed of clay richly impregnated with salt, and sometimes even containing great masses of it. This appears to be the farthest limit of the salt-beds on that side of Germany.

forms hills. The salt-mines of Wieliczka are situated about two leagues south-east of Craucau in West Gallicia, and about nine miles to the north-east of the Carpathian Mountains. They have been worked since the year 1251, and their depth and extent is very great; by some said to be 900 feet, and having an extent of more than a league from east to west. According to Abbé Estner, the salt of Hungary, Transylvania, and West Gallicia, occurs only of a grey colour. The party-coloured is found principally in Upper Austria, Salzburg, Stiria, and the Tyrol *. The beautiful blue foliated variety was formerly found at Ischel in Upper Austria; and the very rare green variety is at present found at Berchtesgaden and Hallein in Salzburg, where the fibrous blue variety which occurs in the Tyrol is also met with.

There are, besides, immense deposites of salt in Old and New Castile in Spain: thus, at Cordona, it is said to form a hill between 300 and 400 feet high; and in France there are salt-springs, but no salt-beds have hitherto been discovered.

Africa.—Besides the great beds of this mineral found in Europe, it is also very extensively distributed in other quarters of the globe. In the northern part of Africa, on both sides of the Atlas Mountains, vast quantities of rock-salt occur. In the valley of Egarement there are beds of rock-salt resting on gypsum. Mr Horneman, on his journey from Cairo to Ummosogeir, discovered a plain on the summit of the chain of limestone mountains that bound the Desart of Lybia to the north, consisting of a mass of rock-salt, spread over so large a tract of surface, that in one direction

* The salt-mines in the Tyrol are 5000 feet above the level of the sea.

rection no eye could reach its termination, and its width he computed at several miles. To the south-east of Abyssinia, there is a plain of rock-salt four days journey across, whence all that country is supplied *. At Tegazza, and in several other places in Sahara, very large beds of pure rock-salt occur under strata of different kinds of solid rock; and beds of salt appear at Darfur, and in the country of Congo.

Asia.—There is a considerable mine of rock-salt twenty versts from Jena-Tayerska, in the desart between the Volga and the Uralian Mountains; another named Iletzki, near Astracan; and there are several others in Siberia †. Salt-mines are worked in that part of China which borders on Tartary. At Teflis, Tauris, and other places in Persia, there are great masses of rock-salt; and we are informed, that in the Desart of Caramania, and also in Arabia, rock-salt is so abundant, and the atmosphere is so dry, that the inhabitants use it for building houses. The Island of Ormuz, situated in the mouth of the Persian Gulf, is principally composed of rock-salt. Rock-salt is one of the mineral productions of the valley of Cashmere; and in the province of Lahore in India, there is a hill of rock-salt equal to that of Cordona: the salt of this hill is cut into dishes, plates, and stands for lamps ‡.

America.—Rock-salt is found in vast quantity on the elevated Desarts of Peru, where it is very hard, and has usually

* Bruce mentions, that in some parts of Abyssinia, cubic pieces of rock-salt pass as current coin.

† Pallas speaks of rock-salt in the neighbourhood of the river Jaik, which is sometimes so hard as to snap the pick-axes made use of in quarrying it.

‡ Pennant's Outlines of the Globe, vol. i. p. 42.

usually a violet colour; also in the Cordilleras of New Granada, at the height of 2000 toises *. It occurs in considerable quantity in Upper Louisiana; and great masses of it have been found at the junction of the stream of Atha-pus-caou with the Atha-pus-caou Lake; and in California.

New Holland.—According to Governor Hunter, it is found in considerable quantity on the east coast of New Holland.

Uses.

Its uses are very various and important. We employ it daily as a seasoning for our food: vast quantities are employed for the preservation of animal flesh, butter, &c.; it is also used as a manure, in the manufacture of earthenware, soap-making, and in many metallurgic operations. It affords muriatic acid and soda, by certain chemical processes. It is sometimes employed in its crude state, but is more commonly purified.

Second Subspecies.

Lake-Salt.

Seesalz, *Werner.*

Seesalz, *Reuss,* b. iii. s. 36. *Id.* *Hoff.* b. iii. s. 231.—Körniges Steinsalz, *Haus.* Handb. b. iii. s. 844.

External Characters.

Its colour is greyish-white.

It

* Humboldt's Personal Narrative, vol. ii. p. 268.

It occurs in coarse and small roundish grains.

Internally it is shining or glistening, and the lustre is resinous.

The fracture is imperfect foliated.

In other characters it agrees with the other subspecies.

Geognostic and Geographic Situations.

It is found on the bottoms and sides of salt-lakes.

Europe.—It is collected in the islands of Cyprus and Milo, in the Mediterranean Sea. Nearly the half of the peninsula of the Crimea is filled with salt-lakes, which afford a great quantity of lake-salt.

Asia.—Lake-salt is collected in the neighbourhood of the Caspian.

Africa.—At Manzelach, near Alexandria, there are two salt-lakes, which afford a great quantity of fine white salt. The bottoms of the salt lakes in the land of the Hottentots and the Caffres, are so compactly covered with salt, that it appears like ice, and the grains or distinct concretions adhere so closely together, that the mass is as hard as stone. Many extensive districts are supplied with salt from the lake of Dombu, which is situated in the great Desart of Bilma, in the kingdom of Bornu.

America.—Lake-salt is collected in several of the salt lakes in North America, as in Mexico.

GEN. II.

Genus II. SAL AMMONIAC.

This genus contains one species, viz. Octahedral Sal Ammoniac. * Mascagnine.

1. Octahedral Sal Ammoniac.

Octaedrisches Salmiac Salz, *Mohs.*

Natürlicher Salmiack, *Werner.*

Sal ammoniacum, *Wall.* t. ii. p. 77.—Sal Ammoniac, *Romé de Lisle*, t. i. p. 382. *Id. De Born*, t. ii. p. 54.——Natürlicher Salmiack, *Wid.* s. 610.—Sal Ammoniac, *Kirw.* vol. ii. p. 33. —Natürlicher Salmiack, *Estner*, b. iii. s. 78. *Id. Emm.* b. ii. s. 24.—Muriate d'Ammoniac, *Lam.* t. i. p. 473.—Le Sel Ammoniaque, *Broch.* t. ii. p. 27.—Ammoniaque muriatée, *Haüy*, t. ii. p. 380. 386.—Salmiack, *Reuss*, b. iii. s. 38. *Id. Lud.* b. i. s. 180. *Id. Suck.* 2ter th. s. 180. *Id. Bert.* s. 328. *Id. Mohs*, b. ii. s. 267.—Ammoniaque muriatée, *Lucas*, p. 25.—Salmiack, *Leonhard*, Tabel. s. 45.—Ammoniac muriatée, *Brong.* t. i. p. 109.—Salmiack, *Karsten*, Tabel. s. 56. *Id. Haus.* s. 122.—Muriate of Ammonia, *Kid*, vol. ii. p. 12.—Salmiak, *Lenz*, b. ii. s. 984.—Natürlicher Salmiack, *Hoff.* b. iii. s. 219. *Id. Haus.* Handb. b. iii. s. 853.—Sal Ammoniac, *Aikin*, p. 251.

This species is divided into two subspecies, viz. Volcanic Sal Ammoniac, and Conchoidal Sal Ammoniac.

First

First Subspecies.

Volcanic Sal Ammoniac.

Vulcanischer Salmiak, *Karsten.*

External Characters.

The colours are yellowish and greyish-white; pearl-grey and smoke-grey; wine-yellow; sometimes apple-green, sulphur-yellow, and brownish-black.

It occurs in efflorescences, crusts, stalactitic, small botryoidal, tuberose, corroded, also in granular concretions, and crystallized, in the following figures:

1. Octahedron.
2. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes.
3. Cube, more or less deeply truncated on the edges.
4. Garnet or rhomboidal dodecahedron.
5. Leucite crystallization, or the double eight-sided pyramid, acuminated with four planes.

The crystals are small and very small; and their lateral planes are usually smooth.

Externally it is dull or glistening; internally shining and vitreous.

Its cleavage is in the direction of the planes of the octahedron.

It alternates from transparent to opaque.

It is harder than talc, and sometimes as hard as selenite.

It is slightly ductile, and elastic.

Specific gravity, 1.5442, *Hassenfratz.*—1.5, 1.6, *Mohs.*

Its taste is sharp and urinous.

Chemical

Chemical Characters.

When moistened, and rubbed with quicklime, it gives out a pungent ammoniacal odour.

Constituent Parts.

	Sal Ammoniac of Vesuvius.
Muriate of Ammonia, -	99.5
Muriate of Soda, -	0.5
	100.0

Klaproth, Beit. b. iii. s. 91.

Geognostic Situation.

As its name implies, it is a volcanic production, occurring in the fissures, or on the surface of volcanic or pseudo-volcanic rocks.

Geographic Situation.

Europe.—It occurs in the vicinity of burning beds of coal, both in Scotland and England. It is found in the Island of Iceland. On the Continent, it is met with at Solfatara, Vesuvius, Ætna, the Lipari Islands, and Tuscany.

Asia.—Thibet, Persia, and the Isle of Bourbon.

America.—In volcanic districts both in North and South America.

Second

Second Subspecies.

Conchoidal Sal Ammoniac.

Muschlicher Salmiak, *Karsten.*

External Characters.

Its colour is greyish-white.

It occurs in angular pieces.

Its surface is uneven.

Externally it is glimmering; internally it is shining and vitreous.

The fracture is nearly perfect conchoidal.

The fragments are indeterminate angular.

It is semi-transparent or transparent.

It is malleable.

It is soft.

It is light.

Its taste is pungent and urinous.

Constituent Parts.

Muriate of Ammonia,	-	97.50
Sulphate of Ammonia,	-	2.50
		100

Klaproth, Beit. b. iii. s. 94

Geognostic and Geographic Situations.

This mineral is said to occur, along with sulphur, in rocks of indurated clay or clay-slate, in the country of Bucharia.

Uses.

Uses.

This salt is used for a variety of purposes. Great quantities of artificial sal ammoniac are annually exported from this country to Russia, where it appears to be used by the dyers. It is employed by coppersmiths, to prevent the oxidation of the surface of the metals they are covering with tin. It has the property of rendering many metallic oxides volatile, and is frequently used to separate metals from each other. Dissolved in nitric acid, it forms the fluid named *aqua regia*, employed in the solution of gold; and pure ammonia is also obtained from this salt.

Observations.

It is an opinion entertained by many, that this salt is the same with the sal ammoniac (ἁλς ἀμμωνιακως) of the ancients; but the accounts of Pliny, Dioscorides, Collumella, Synesius, Herodotus, Strabo, and Arrian, prove that they understood by sal ammoniac rock-salt; and even the ancient Arabian physicians Avicenna and Serapion, who flourished during the eleventh century, describe rock-salt under the name sal ammoniac. The first account we have of sal ammoniac is in a treatise of Geber's, the date of which is uncertain.—Vid. Beckman, Beiträge zur Geschichte der Erfindungen, b. v. s. 254,—285.

Mascagnine.

* Mascagnine ([a]), or Sulphate of Ammonia.

Mascagnin, *Karsten*.

Mascagnin, *Reuss*, b. ii. 3. s. 45. *Id. Karsten*, Tabel. s. 56.—Ammoniaque sulphatée, *Haüy*, Tabl. p. 21.—Mascagnin. *Lenz*, b. ii. s. 985.

External Characters.

Its colours are yellowish-grey and lemon-yellow.
It occurs in mealy crusts, or stalactitic.
Internally it is dull or glistening.
The fracture is uneven or earthy.
It is semi-transparent or opaque.
Its taste is sharp and bitter.

Chemical Characters.

It is easily soluble in water; partly volatilised by heat: and becomes moist on exposure to the air.

Constituent Parts.

It is a compound of Ammonia, Sulphuric Acid, and Water.

Geognostic and Geographic Situations.

It occurs among the lavas of Ætna, and Vesuvius; in the Solfatara by Puzzæolo; in the lagunes, near Siena in Tuscany; and on the bottom of a hot spring in Dauphiny.

GEN. III.

(a) It is named after the discoverer M. Mascagni.

GENUS III. VITRIOL.

THIS Genus contains three species, viz. 1. Rhomboidal Vitriol, or Green Vitriol, 2. Prismatic Vitriol, or Blue Vitriol, 3. Pyramidal Vitriol, or White Vitriol. * Red Vitriol.

1. Rhomboidal Vitriol, or Green Vitriol.

Rhomboedrisches Vitriol Salz, *Mohs.*

Eisen Vitriol, *Werner.*

Στυπτηρια of the Greeks.—Alumen, *Plin.* xxxv. 15. p. 52.—Chalcanthum, *Plin.* ?—Vitriolum ferri, *Waller.* Syst. Min. ii. p. 22.—Fer sulphatée, *Haüy,* t. iv. p. 122.—Eisen Vitriol, *Reuss,* b. ii. 3. s. 68. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 137.—Sulphat of Iron, *Kid,* vol. ii. p. 20.—Eisenvitriol, *Lenz,* b. ii. s. 989.—Green Vitriol, *Aikin,* p. 250.

External Characters.

Its colours are emerald, apple, and verdigris green, and sometimes grass-green: on exposure to the weather, it becomes straw-yellow, cream-yellow, ochre-yellow, and yellowish-brown.

It occurs pulverulent, massive, disseminated, stalactitic, tuberose, botryoidal, reniform, in fibrous distinct concretions, and crystallized.

The primitive figure is a rhomboid with edges of 81° 23′ and 98° 37′, and plane angles of 100° 10′, and 79° 50′. The diagonally opposite apices of this rhomboid are sometimes truncated; occasionally all the angles, or the angles and edges, are truncated.

It is shining both externally and internally, and the lustre is vitreous, with exception of the fibrous varieties, which are pearly.

Its cleavage is threefold, and in the direction of the planes of the rhomboid.

The fracture is flat conchoidal.

It alternates from semi-transparent to opaque.

It refracts double.

It is as hard as gypsum.

It is friable, brittle, and easily frangible.

Specific gravity, 1.9, 2.0. *Mohs.*

It tastes sweetish, styptic, and metallic.

Chemical Character.

Before the blowpipe, on charcoal, it becomes magnetic, and colours glass of borax green.

Constituent Parts.

Oxide of Iron,	-	25.7
Sulphuric Acid,	-	28.9
Water,	-	45.4
		100.0 *Berzelius*

Geognostic and Geographic Situations.

It is always associated with iron-pyrites, by the decomposition of which it is formed. It occurs in several coal-mines

mines in this country, and in many iron and coal mines on the Continent of Europe; and also in America, and Asia.

Uses.

It is employed to dye linen yellow, and wool and silk black: in the preparation of ink; of Berlin-blue; for the precipitation of gold from its solution; and sulphuric acid can be obtained from it by distillation. The residue of the latter process (colcothar of iron) is used as a red paint, and, when washed, for polishing steel.

Observations.

Vitriol of iron, by exposure, becomes yellow, and at last brown: in this state, it appears to answer to the *Misy*, Plin. Hist. Nat. xxxiv. 31. The Melanteria, or Inkstone of Pliny, the Lapis atramentarius flavus of Wallerius, appears to be a variety of this mineral.

2. Prismatic Vitriol, or Blue Vitriol.

Prismatisches Vitriol-Salz, *Mohs.*

Kupfervitriol, *Werner.*

Χαλκανθον of the Greeks.—Chalcanthum atramentum sutorium, *Plin.* Hist. Nat. xxxiv. 12. p. 32.—Vitriolum cupri, *Walter* Syst. Min. t. ii. p. 20.—Cuivre suphatée, *Haüy*, t. iii. p. 580. —Kupfervitriol, *Reuss*, b. ii. 3. s. 73. *Id. Karst.* Tabel. s. 56. —Sulphate of Copper, *Kid*, vol. ii. p. 23.—Kupfervitriol, *Lenz*, b. ii. s. 993. *Id. Haus.* Handb. b. iii. s. 1053.—Blue Vitriol, *Aikin*, p. 249.

External Characters.

The common colour is dark sky-blue, which sometimes approaches to verdigris-green. By exposure to the air it becomes yellow.

It occurs massive, disseminated, stalactitic, dentiform; and crystallized.

Its primitive figure is an oblique four-sided prism, in which the lateral edges are 124° 2′, and 55° 58′. The edges and angles of this prism frequently occur truncated.

Externally and internally it is shining and vitreous.

It has a double cleavage in the direction of the lateral planes of the oblique four-sided prism.

The fracture is conchoidal.

The fragments are rather sharp-edged.

It is translucent.

It is harder than gypsum, but not so hard as calcareous-spar.

Specific gravity, 2.1, 2.2, *Mohs.*

Its taste is nauseous, bitter, and metallic.

Chemical Characters.

When a portion of it is dissolved in water, and spread on the surface of iron, it immediately covers it with a film of copper.

Constituent Parts.

Oxide of Copper,	-	32.13
Sulphuric Acid,	-	31.57
Water,	-	36.30
		100.00 *Berzelius.*

Geognostic

Geognostic and Geographic Situations.

It occurs, along with copper-pyrites, in Pary's mine in Anglesea; and also in the copper-mines in the county of Wicklow, in Ireland. It is found in considerable quantity in several copper-mines on the Continent of Europe; and also in Siberia.

Uses.

It is used in cotton and linen printing, and the oxide separated from it is used by painters.

3. Pyramidal Vitriol, or White Vitriol.

Vitriolum zinci, *Waller*. Syst. Min. t. ii. p. 24.—Zinc sulphatée, *Haüy*, t. iv. p. 180.—Zinkvitriol, *Leonhard*, Tabel. s. 45. *Id. Karsten*, Tabel. s. 56.—White Vitriol or Sulphate of Zinc, *Kid*, vol. ii. p. 24.—Zinkvitriol, *Lenz*, b. ii. s. 996. *Id. Haus.* Handb. b. iii. s. 1118.—White Vitriol, *Aikin*, p. 250.

External Characters.

Its colours are greyish, yellowish, reddish, and greenish-white.

It occurs massive, stalactitic, reniform, botryoidal, in crusts; also in radiated, fibrous and granular distinct concretions; and crystallized.

Its primitive figure is a pyramid of 120° 90′. The following are some of the secondary figures:

1. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes.
2. Acicular crystals, which are promiscuously aggregated.

It

It is shining.
It is translucent.
It is soft, brittle, and easily frangible.
Specific gravity, 2.00, *Born.*
Its taste is nauseous metallic.

Chemical Characters.

It intumesces before the blowpipe, but does not phosphoresce: it dissolves in 2.285 parts of boiling water.

Constituent Parts.

	From Rammelsberg.	Ditto.
Oxide of Zinc, -	27.5	21.739
Oxide of Manganese,	0.5	6.522
Sulphuric Acid, -	22.0	71.739
Water, -	50.0	
	100.0	100
	Klaproth, Beit. b. v. s. 196.	*Herz.* Archiv. b. iii. s. 537.

Geognostic and Geographic Situations.

It occurs in repositories that contain blende, and appears to be formed by the decomposition of that mineral. It occurs at Holywell in Flintshire; and it is said also in Cornwall: in the Ramelsberg in the Hartz; at Spitz in Austria; at Schemnitz in Hungary; and Sahlberg in Sweden.

Uses.

It is used as a medicine; is employed in great quantities by varnishers to make oil drying; and a fine white colour named

named *Zinc-white*, which is more durable than white-lead, is prepared from it. To prepare this colour, the salt is dissolved in water, and the white oxide, which is the zinc-white, is precipitated from it by means of potash or chalk.

Red Vitriol, or Sulphate of Cobalt.

Kobaltvitriol, *Werner*.

Kobaltvitriol, *Kopp*, in Leonhard's Taschenbuch, b. i. s. 111. *Id. Leonhard*, Tabel. s. 45. *Id. Karsten*, Tabel. s. 56. *Id. Lenz*, b. ii. s. 1003.—Red Vitriol, *Aikin*, p. 250.

External Characters.

Its colour is flesh-red, inclining to rose-red.

It occurs coralloidal, stalactitic, in crusts; also in granular distinct concretions.

The surface is rough, and longitudinally furrowed.

It is dull, and seldom shining on the surfaces of the distinct concretions, and the lustre is pearly.

The fracture is earthy.

The fragments are blunt-edged.

It is opaque.

It affords a yellowish-white streak.

It is easily friable, and brittle.

It is light.

It tastes styptic.

Chemical Characters.

Its solution affords, with carbonate of potash, a pale-bluish precipitate, which tinges borax of a pure blue colour.

Constituent

Constituent Parts.

Oxide of Cobalt,	-	38.71
Sulphuric Acid,	-	19.74
Water,	- -	41.55
		100.00

Koppe, in Journal fur die Chemie, Physik et Mineralogie, b. vi. Heft 1. 1808, s. 157.

Geognostic and Geographic Situations.

It occurs in mining-heaps in Biber, along with lamellar heavy-spar, earthy cobalt, and grey cobalt; and it has been also found in the Leogang at Salzburg.

GENUS IV. EPSOM SALT.

This Genus contains one species, viz. Prismatic Epsom Salt.

1. Prismatic Epsom Salt.

Prismatisches Bitter Salz, *Mohs.*

Naturlicher Bitter Salz, *Werner.*

Σχιστη στυπτηρια of the Greeks.—Trichitis, *Plin.* Hist. Nat. xxxv. 15. 2. 52.?—Sal neutrum acidulare, *Wall.* t. ii. p. 71.—Sal d'Epsom; Sel de Sedlitz; Sel d'Angleterre; Vitriol de Magnesia, *Romé de Lisle,* t. i. p. 306.—Natürlicher Bittersalz, *Wid.*

Wid. s. 595.—Epsom Salt, *Kirw.* vol. i. p. 12.—Natürlicher Bittersalz, *Estner,* b. iii. s. 44. *Id. Emm.* b. ii. s. 14.—Le Sel amere natif, ou Le Sel d'Epsom natif, *Broch.* t. ii. p. 11.—Magnesie sulphatée, *Haüy,* t. ii. p. 331.–336.—Bittersalz, *Reuss,* b. iii. s. 53. *Id. Lud.* b. i. s. 182. *Id. Suck.* 2ter th. s. 21. *Id. Bert.* s. 324. *Id. Mohs,* b. ii. s. 271. *Id. Leonhard,* Tabel. s. 46.—Magnesie sulphatée, *Brong.* t. i. p. 165.—Haarsalz, *Karsten,* Tabel. s. 56.—Bittersalz-fasriges, haarförmiges, & mehliges, *Haus.* s. 120. *Id. Lenz,* b. ii. s. 1015.—Natürlich Bittersalz, *Hoff.* b. iii. s. 243.—Sulphat of Magnesia, *Aikin.* p. 251.

External Characters.

Its colours are snow-white, greyish-white, and yellowish-white, and sometimes ash-grey, and smoke-grey

It occurs in farinaceous crusts, in flakes, small botryoidal, reniform, and crystallized.

Its primitive figure is a prism of 90°. The prisms are acicular and capillary *.

It has a distinct cleavage in the direction of one of the diagonals of the prism.

The farinaceous variety is dull, the others shining, or glistening, and pearly.

It varies from transparent to opaque.

It is soft.

It is brittle, and easily frangible.

Its taste is bitter and saline.

Chemical

* The crystallizations of Artificial Epsom Salt are the following:

1. Rectangular four-sided prism, either bevelled on the extremities, or acuminated with four planes.
2. Six-sided prism, acuminated on the extremities with four planes, and the edges of the acumination truncated.

Chemical Characters.

Before the blowpipe, it dissolves very easily by the assistance of its water of crystallization, but it is difficultly fusible. Its solution gives a precipitate with lime-water.

Constituent Parts.

The constituent parts of purified Epsom Salt, the Sulphate of Magnesia of chemists, are, according to

	Bergmann.	*Kirwan.*
Sulphuric Acid, -	33.0	29.46
Magnesia, -	19.0	17.00
Water of Crystallization,	48.0	53.54
	100.0	100.00

Geognostic and Geographic Situations.

It occurs as an efflorescence at Hurlet, near Paisley, along with natural alum; and sometimes effloresces on old walls: at Jena it encrusts rocks of gypsum; and half burnt clay at Witschiz in Bohemia; on porphyry-slate, also in Bohemia; at Solfatera, on decomposing lava; at Gran, in Hungary, it effloresces on sandstone, clay, and compact limestone.

Uses.

When purified, it is used as a purgative medicine; and it is valued by chemists on account of the magnesia which can be obtained from it.

GEN. V.

GENUS V. ALUM.

THIS Genus contains one species, viz. Octahedral Alum.
* Rock Butter.

1. Octahedral Alum.

Octaedrisches Alaun, *Mohs.*

Natürlicher Alaun, *Werner.*

Alumen nativum, *Wall.* t. i. p. 31.—Natürlicher Alaun, *Wid.* s. 593.—Alum, *Kirw.* vol. ii. p. 13.—Natürlicher Alaun, *Estner,* b. iii. s. 39. *Id. Emm.* b. ii. s. 9.—L'Alumen natif, *Broch.* t. ii. p. 6.—Alumine sulphatée alkaline, *Haüy,* t. ii. p. 387. 398.—Alumine sulphatée, *Brong.* t. i. p. 155.—Sulphat of Alumine, *Kid,* vol. ii. p. 13.—Alaun, *Haus.* Handb. b. iii. s. 813.

External Characters.

Its colours are yellowish, and greyish-white.

It occurs as a farinaceous efflorescence, stalactitic, in delicate curved and parallel fibrous concretions; also crystallized, in octahedrons and cubes.

The varieties with fibrous concretions have a pearly lustre; others are glistening and vitreous.

The cleavage is fourfold, and in the direction of the planes of the octahedron.

When the fracture can be observed, it is conchoidal.

It is rather harder than gypsum.

Specific

Specific gravity, 1.7, 1.8.
Its taste is sweetish astringent.

Chemical Characters.

It is soluble in from sixteen to twenty times its weight of water. It melts easily by means of its water of crystallization; and by continuance of the heat, it is converted into a white spongy mass.

Constituent Parts.

	Natural Alum of Freinwald.
Alumina, - -	15.25
Potash, - -	0.25
Oxide of Iron, -	7.50
Sulphuric Acid, and Water,	77.00
	100.00

Klaproth, Beit. b. iii. s. 103.

Geognostic Situation.

It generally occurs as an efflorescence on aluminous minerals, as alum-slate, alum-earth, alum-stone, aluminous-coal, aluminous-slate-clay, and bituminous shale, and also encrusting lavas.

Geographic Situation.

Europe.—It occurs as an efflorescence on the surface of bituminous-shale and slate-clay at Hurlet, near Paisley; also encrusting alum-slate near Moffat, in Dumfriesshire; Ferrytown of Cree, in Galloway; and at Whitby, in Yorkshire. On the Continent of Europe, it is met with in many places, as in the alum-slate rocks near Christiania in Norway;

Norway; in coal-mines in Bohemia; also in Austria, Bavaria, Hungary, Italy, and the islands of Stromboli, Milo, &c. in the Mediterranean Sea.

Africa.—In Egypt.

America.—In Real del Monte in Mexico, on a porphyritic stone.

Uses.

It is employed as a mordant in dying; also in the manufacture of leather and paper; as a medicine; for preserving animal substances from putrefaction; and it is sometimes mixed with bread, in order to give it a whiter colour.

Observations.

1. The minerals that afford alum, either contain it ready formed, or only its constituent parts, which are disposed to unite, and form alum, when placed in favourable circumstances. This latter is the most frequent case.

2. The Romans and Grecians appear to have been unacquainted with alum: the *alumen* of the Romans, and the στυπτηρια of the Greeks, being vitriol of iron.

3. Beds and veins of native alum, in fibrous concretions, have been lately discovered at Tschermig in Bohemia. Its chemical composition is remarkable, as appears from the following analysis of Ficinus:

Alumina 10.1, Magnesia 1.4, Sulphuric Acid 43.24, Water of Crystallization 44.56, Silica 0.2 = 100. The magnesia here takes the place of the potash.

* Rock-Butter (a).

Bergbutter, *Werner.*

Bergbutter, *Wid.* s. 589. *Id. Emm.* b. ii. s. 13.—Le Beurré de Montagne, ou Le Bergbutter, *Broch.* t. ii. p. 10.—Bergbutter, *Reuss,* b. iii. s. 66. *Id. Lud.* b. i. s. 182. *Id. Suck.* 2ter th. s. 26. *Id. Bert.* s. 323. *Id. Leonhard,* Tabel. s. 46. *Id. Karsten,* Tabel. s. 56. *Id. Haus.* s. 119. *Id. Lenz,* b. ii. s. 1009.

External Characters.

The colours are yellowish-white, yellowish-grey, cream-yellow, straw-yellow, and pale sulphur-yellow.

It occurs massive, and tuberose.

Internally it is strongly glimmering, and resinous.

The fracture is straight foliated.

The fragments are blunt-edged.

It is translucent on the edges.

It feels rather greasy.

It is easily frangible.

Constituent Parts.

It is Alum, mixed with Alumina and Oxide of Iron.

Geognostic Situation.

It oozes out of rocks that contain alum, or its constituents, as alum-slate, bituminous-shale impregnated with iron-pyrites, or alum-earth.

Geographic

* It is named *Rock-Butter,* from oozing out of the fissures of alum rocks in a soft buttery state. It afterwards becomes solid.

Geographic Situation.

It occurs at the Hurlet Alum-work, near Paisley; oozing out of rocks of alum-slate in the island of Bornholm, in the Baltic; at Muskau in Upper Lusatia; Saalfeld in Thuringia; and, according to Pallas, in aluminous rocks on the banks of the river Jenisei, in Siberia.

GENUS VI.—GLAUBER SALT.

THIS Genus contains one species, viz. Prismatic Glauber Salt. * Reussite.

1. Prismatic Glauber Salt.

Prismatisches Glauber Salz, *Mohs.*

Natürliches Glauber Salz, *Werner.*

Sal mirabile, *Wall.* t. ii. p. 70.—Sel de Glauber, *Romé de Lisle,* t. i. p. 301. *Id. Born,* t. ii. p. 26.—Natürliches Wundersalz, *Wid.* s. 597.—Glauber Salt, *Kirw.* vol. ii. p. 9.—Natürliches Glaubersalz, *Estner,* b. iii. s. 50. *Id. Emm.* b. iii. s. 401.—Le Sel de Glauber natif, *Broch.* t. ii. p. 14.—Glaubersalz, *Reuss,* b. iii. s. 49. *Id. Lud.* b. i. s. 183. *Id. Suck.* 2r th. s. 18. *Id. Mohs,* b. ii. s. 273. *Id. Leonhard,* Tabel. s. 46.—Soude sulphatée, *Brong.* t. i. p. 113.—Glaubersalz, *Karsten,* Tabel. s. 56.—Glauberite, *Haus.* s. 120.—Soude sulphatée, *Haüy,* Tabl. p. 19.—Glaubersalz, *Lenz,* b. ii. s. 1027. *Id. Hoff.* b. iii. s. 245. *Id. Haus.* Handb. b. iii. s. 835.

External

External Characters.

Its colours are greyish and yellowish white; seldom snow or milk white.

It occurs in the form of mealy efflorescences; in crusts; seldom stalactitic, small botryoidal, reniform; in small and fine granular distinct concretions; and crystallized in prisms, the dimensions of which are unknown. The crystals are often acicular.

Internally it is shining, and the lustre is vitreous.

The crystallized varieties have a threefold cleavage. The fracture is conchoidal, or uneven.

The fragments are indeterminately angular, and blunt-edged.

It is soft.

It is brittle, and easily frangible.

Specific gravity 2.2, 2.3.

Its taste is first cooling, and then saline and bitter.

Chemical Characters.

Before the blowpipe, it is affected in the same manner as Epsom salt; but its solution does not, like that of Epsom salt, afford a precipitate with an alkali.

Constituent Parts.

Natural Glauber Salt of Eger, according to Reuss, (Chemische-medicinische Beschreibung des Kaiser Franzens Bades, Dresden, 1794), contains,

Sulphate of Soda,	- -	67.024
Carbonate of Soda,	- -	16.333
Muriate of Soda,	- -	11.000
Carbonate of Lime,	- -	5.643
		100

Geognostic

Geognostic Situation.

It occurs, along with rock-salt and Epsom salt, on the borders of salt-lakes, and dissolved in the waters of lakes; in efflorescences on moorish ground; also on sandstone, marl-slate, and old and newly built walls.

Geographic Situation.

Europe.—At Eger in Bohemia, it occurs efflorescent on meadow-ground; as an efflorescence on the walls of old galleries in mines, at Grenoble in France; in old salt-mines at Aussee, Ischel and Hallstadt, in Upper Austria; at Altenberg in Stiria; Felsobanya in Hungary; Hildesheim; Durrenberg, near Hallein in Salzburg; Schwartzburg in Switzerland; near Aranjuez in Spain; Solfatara in Italy.

Asia.—It occurs on the banks, and in the water of many Siberian salt-lakes; neighbourhood of the Lake Baikal; the desert plains of Iset, Ischem, and Barebyn.

Africa.—Egypt.

Uses.

It is used as a purgative medicine; and in some countries as a substitute for soda, in the manufacture of white glass.

* Reussite.

Reussin, *Karsten.*

Reussin, *Karsten,* Tabel. (1. Ausg. 46. 75.) *Id. Leonhard,* Tabel. s. 46. *Id. Reuss,* Min. ii. 3. 46.—*Karsten,* Tabel. 2. Ausg. s. 56. *Id. Lenz,* b. ii. s. 1019.

 External

External Characters.

Its colours are snow-white and yellowish-white, which latter inclines to wine-yellow.

It occurs as a mealy efflorescence, in loose, earthy, dull particles: and crystallized in

1. Flat six-sided prisms, with two broad, and four narrow lateral planes, and bevelled on the extremities.
2. Acicular crystals.

The first are small and middle-sized, the latter loose, or scopiformly aggregated.

Internally it is shining and vitreous, and the fracture of the crystals small conchoidal.

It is soft.

Constituent Parts.

Sulphate of Soda, - -	66.04
Sulphate of Magnesia, -	31.35
Muriate of Magnesia, - -	2.19
Sulphate of Lime, - -	0.42
	100.0

Reuss, in Crell's Annalen, 1791, 11. 18.

Geognostic and Geographic Situations.

It is found in the country around Sedlitz and Saidschutz, where it effloresces on the surface during the spring of the year: also at Pilln, near Brüx.

GEN. VII.

Genus VII.—NITRE.

This Genus contains but one species, viz. Prismatic Nitre.

1. Prismatic Nitre.

Prismatisches Natürlicher Saltpeter, *Mohs.*

Natürlicher Salpeter, *Werner.*

Nitrum terra mineralisatum, *Wall.* t. ii. p. 45.—Nitrate de Potasse, *De Born,* t. ii. p. 57.—Natürlicher Salpeter, *Wid.* s. 602. Nitre, *Kirw.* vol. ii. p. 25.—Natürlicher Salpeter, *Estner.* b. iii. s. 55. *Id. Emm.* b. ii. s. 16.—Nitrate de Potasse, *Lam.* t. i. p. 468.—Potasse nitratée, *Haüy,* t. ii. p. 346. 355.—Le Nitre natif, *Broch.* t. ii. p. 17.—Salpeter, *Reuss,* b. iii. s. 21. Natürlicher Salpeter, *Lud.* b. i. s. 177. *Id. Suck.* 2ter th. s. 9. *Id. Bert.* s. 325.—Potasse nitratée, *Lucas,* p. 21.—Salpeter, *Leonhard,* Tabel. s. 44.—Potasse nitratée, *Brong.* t. i. p. 112.—Salpeter, *Karsten,* Tabel. s. 56. *Id. Haus.* s. 121.—Nitrate of Potash, *Kid,* vol. ii. p. 3.—Natürlicher Salpeter, *Hoff.* b. iii. s. 216. *Id. Haus.* Handb. b. iii. s. 849. —Nitre, *Aikin,* p. 251.

External Characters.

Its colours are greyish-white, yellowish-white, and snow-white.

It occurs in flakes, crusts, and in capillary prismatic crystals. The primitive prism has not been determined.

It is dull, glimmering, or shining, and the lustre vitreous.

It has a cleavage in the direction of the smaller diagonal of the oblique four-sided prism.

It alternates from translucent to transparent.

It is as hard as gypsum.

It is brittle, and easily frangible.

Its taste is cooling and saline.

Specific gravity, 1.9369, *Hassenfratz.*—1.9, 2.0, *Mohs.*

Chemical Characters.

It deflagrates when thrown on hot coal.

Constituent Parts.

The Natural Nitre of Molfetta, according to Klaproth:

Nitrate of Potash, -	42.55
Sulphate of Lime, -	25.45
Carbonate of Lime, -	30.40
Muriate of Potash ? -	0.20
Loss, - - - - -	1.40
	100.00

Klaproth, Beit. b. i. s. 320

Geognostic Situation.

It is usually found in thin crusts on the surface of soil, and sometimes also covering the surface of compact limestone, chalk, and calc-tuff. In many countries it germinates in certain seasons out of the earth, and when this earth is accumulated in heaps, so as to expose a large surface to the atmosphere, it is found to produce it annually.

Geographic

Geographic Situation.

Europe.—It is found in great quantities in many plains in Spain; very abundantly in the plains of Hungary, the Ukraine and Podolia; in France, on the walls and floors of chalk caves; in the county of Bamberg, on a species of limestone marl; on marly sandstone in the neighbourhood of Göttingen; at Hornberg, near Wurzburg, encrusting calc-tuff. But the most remarkable repository of natural nitre in Europe, is that discovered by Abbé Fortis, near Molfetta, in the kingdom of Naples. It there occurs encrusting a yellowish-grey coloured compact limestone. It is never found in beds with the limestone, as mentioned by some mineralogists, but always on its surface.

Asia.—Nitre is very abundant in India; also in Persia; and in the valley between Mount Sinai and Suez, in Arabia.

Africa.—This salt is abundant in Egypt; also at Ludamar, in the interior of Africa; and in the Karoo Desart, to the east of the Cape of Good Hope.

America.—The nitre used for the manufacture of gunpowder in the United States of America, is obtained from an earth collected in the limestone caves of Kentucky. The earths which exist in these caves, and which contain both nitre and nitrate of lime, are lixiviated, and the lixivium is then made to pass through wood-ashes, by the alkali of which the nitrate of lime is decomposed *. After due evaporation, the nitre is permitted to crystallize. One of the most remarkable of these caverns is in Madison county, on Crooked Creek, about 60 miles S.E. from Lexington. The cavern

* It appears, that two bushels of ashes, made by burning the dry wood in hollow trees, contain as much alkali as eighteen bushels of ashes obtained from the oak.

cavern extends entirely through a hill, and affords a convenient passage for horses and waggons. Its length is 646 yards; its breadth is generally about 40 feet; and its average height about 10 feet. One bushel of the earth in this cavern commonly yields from one to two pounds of nitre; and the same salt has been found to exist at the depth of at least 15 feet; even the clay is impregnated with nitrate of lime.

Kentucky also furnishes native nitre under a very different form, and constituting what is there called *rock-ore*, which is in fact a sandstone richly impregnated with nitrate of potash. The sandstone rests on limestone, and sometimes presents fronts of from 60 to 100 feet high. When broken into small fragments, and thrown into boiling water, the stone soon falls into sand, one bushel of which, by lixiviation and crystallization, frequently yields 10 lb. and sometimes more than 20 lb. of nitre. The nitre obtained from these rocks contains little or no nitrate of lime, and is said to be superior for the manufacture of gunpowder to that extracted from the afore-mentioned earth. Masses of native nitre, nearly pure, and weighing several pounds, are sometimes found in the fissures of these sandstones, or among detached fragments. Indeed, it is said, that these masses of native nitre sometimes weigh several hundred pounds. Similar caverns also occur in Tennessee, and in some parts of Virginia and Maryland *.

Nitre effloresces in considerable abundance on the soil near Lima; and in Tucuman in South America.

Uses.

In Hungary, Spain, Molfetta, and the East Indies, considerable qantities of natural nitre are collected; but the greatest

* Cleaveland's Mineralogy, p. 109.

greatest proportion of that used in commerce, is obtained by working artificial nitre beds. These consist of the refuse of animal and vegetable bodies, undergoing putrefaction, mixed with calcareous and other earths. Its principal use is in the fabrication of gunpowder: it is also used in medicine, and many of the arts.

GENUS VIII.—NATRON.

THIS Genus contains one species, viz. Prismatic Natron.

1. Prismatic Natron.

Prismatisches Natron Salz, *Mohs.*

Natürliches Mineral Alkali, *Werner.*

This species is divided into two subspecies, viz. Common Natron and Radiated Natron.

First Subspecies.

Common Natron.

Gemeines Natron, *Werner.*

Nitrum, *Plin.* Hist. Nat. xxxi. 10. p. 46.—Alkali minerale natron, *Wall.* t. ii. p. 61.—Alkali fixe mineral, *Romé de Lisle,* t. i. p. 146.—Natürliches mineral alkali, *Wid.* s. 579.—Natron, *Kirw.* vol. ii. p. 6. *Id. Estner,* b. iii. s. 18.—Natürliches mineral alkali, *Emm.* b. ii. s. 31.—Carbonate de Natron, *Lam.*

t. i.

t. i. p. 462.—Soude carbonatée, *Haüy*, t. ii. p. 373. 379.—L'Alkali mineral, ou Le Carbonate de Soude, *Broch.* t. ii. p. 30.—Natron, *Reuss*, b. iii. s. 4.—Natürliches Mineral Alkali, *Lud.* b. i. s. 176. *Id. Suck.* 2 th. s. 2. *Id. Bert.* s. 331. *Id. Mohs*, b. ii. s. 254.—Gemeines Natron, *Leonhard*, Tabel. s. 44.—Soude carbonatée, *Brong.* t. i. p. 149.—Gemeines Natron, *Karsten*, Tabel. s. 56.—Soda, *Haus.* s. 120.—Carbonate of Soda, *Kid*, vol. ii. p. 4.—Soude carbonatée, *Haüy*, Tabl. p. 21.—Gemeines Natron, *Lenz*, b. ii. s. 960.—Nitrum, *Haus.* Handb. b. iii. s. 831.—Natürliches Mineral Alkali. *Hoff.* b. iii. s. 212.—Natron, *Aikin*, p. 153.

External Characters.

Its colours are yellowish and greyish white; also smoke-grey and cream-yellow.

When fresh, it is compact, sometimes granular, sometimes radiated *, vitreous and glistening, and more or less translucent: when weathered, it is in loose, dull, opaque parts.

Its primitive form is an oblique four-sided prism, said to have angles of 120° and 60°.

It has an urinous and saline taste.

Specific gravity 1.4.

Chemical Characters.

It effervesces with acids. Is easily soluble in water, and its solution colours blue vegetable tinctures green. It is very fusible before the blowpipe.

Constituent

* The crystallization of Artificial Soda,—for that of Natural Soda has not been met with,—is an oblique four-sided prism, bevelled on the terminal planes.

According to Haüy, the primitive form of soda is a rhomboidal pyramid, in which the angles of the base are 120° 60′, and of the edges of the base 78° 28′.

Constituent Parts.

Egyptian Natron.		Bohemian Natron.		Natron of Hungary.	
Dry sub-carbonate of Soda,	32.6	Cabonate of Soda,	89.18	Carbonate of Soda,	14.2
Dry Sulphate of Soda,	20.8	Carbonate of Lime,	7.44	Muriate of Soda,	22.4
Dry Muriate of Soda,	15.0	Carbonate of Magnesia,	1.35	Sulphate of Soda,	9.2
Water,	31.6	Extractive matter,	2.03	Earthy residuum,	9.2
				Water,	45.0
	100.0		100.00		100.0
Klaproth, Beit. b. iii. s. 80.		*Reuss*, Min. b. iii. s. 5.		According to *Lampadius*.	

Geognostic Situation.

It occurs as an efflorescence on the surface of soil,—on decomposing rocks of particular kinds,—on the sides and bottoms of lakes that become dry during the summer season,—also on the walls and bottoms of caves,—and dissolved in the water of lakes and springs. In Hungary, according to Ruckert and Pazmand, there are so many natron lakes, that 50,000 quintals of soda could be obtained from them annually. In some places of the same country, it effloresces on the surface of the soil, heath, &c. According to Dr Reuss, it is observed efflorescing on meadows near Priesen and Sebnitz in Bohemia, and on decomposing gneiss in the vicinity of Bilin, where it is renewed every spring. To the west of the Delta of Egypt are several lakes, some of which hold carbonate of soda, or natron, in solution, others muriate of soda, or common salt. In some of these lakes both these salts are contained, and are deposited alternately on the sides of the lake, in consequence of the evaporation of the water that held them in solution, this alternate deposition depending on the different degrees of the

the solubility of these salts: the common salt being the least soluble, is first crystallized; and when that has been separated, to such an extent as to leave a considerable excess of carbonate of soda or natron in solution, then this latter substance begins to crystallize. Berthollet is of opinion, that the natron is formed by the decomposition of the common salt by means of carbonate of lime, during which process the lime unites with the muriatic acid of the common salt, forming with it muriate of lime, while the carbonic acid thus disengaged from the lime, unites with the soda, and thus forms the natron. In some of the lakes, the eastern part contains only common salt, and the western natron, and these two solutions never mix together. It effloresces on the surface of lava in Italy; and in Switzerland and France, on the walls and roofs of caves.

Geographic Situation.

Europe.—It occurs in Bohemia, at Bilin, Carlsbad and Eger; in Hungary, in the neighbourhood of Debrezin, district of Bahar, &c.; in Switzerland, at Schwartzberg, in the canton of Berne; in the Phlegrean Fields, Monte Nuovo, near Naples; and Mount Ætna in Sicily.

Africa.—It occurs in considerable quantity in Egypt at the town of Nitria; in the valley of the Natron Lakes, Nubia; and the island of Teneriffe.

Asia.—In the vicinity of Smyrna, and the ancient city of Ephesus; in Bengal; near Bombay; near Tegapatnam, on the western coast of India; Sina, in the neighbourhood of Pekin; in Thibetian Tartary; Persia; Natolia; district of Ochotsk, in the government of Irkutsk; in the neighbourhood of Nertschinsk in Siberia; and in the Crimea.

America.—Dissolved in the lakes of Mexico.

Second

Second Subspecies.

Radiated Natron.

Strahliches Natron, *Klaproth.*

Strahliges Natron, *Reuss,* b. ii. 3. s. 3. 9. *Id. Leonhard,* Tabel s. 44. *Id. Karsten,* Tabl. s. 56.—Trona, *Haüs.* s. 120.—Soude carbonatée aciculaire, *Haüy,* Tabl. p. 21.—Strahliches Natron, *Lenz,* b. ii. s. 961.

External Characters.

Its colours are greyish and yellowish white.

It occurs in crusts, in radiated distinct concretions, and crystallized in capillary or acicular crystals, which are aggregated on one another.

The lustre is glistening and vitreous.

It is translucent.

It has a urinous and saline taste.

Chemical Characters.

Same as those of Common Natron.

Constituent Parts.

Water of Crystallization, -	22.50
Carbonic Acid, - - -	38.00
Pure Soda, - - -	37.00
Sulphate of Soda, - -	2.50
	100.00

Klaproth, Beit. b. iii. s. 87.

Geognostic

Geognostic and Geographic Situations.

Mr Bagge, Swedish Consul at Tripoli, gives the following information respecting this interesting subspecies of natron. "The native country of this natron, which is there called *Trona*, is the province Sukena, two days journey from Fezzan. It is found at the bottom of a rocky mountain, forming crusts, usually the thickness of a knife, and sometimes, although rarely, of an inch, on the surface of the earth. It is always crystalline: in the fracture it consists of cohering, longish, parallel, frequently radiated crystals, having the aspect of unburnt gypsum. Besides the great quantity of trona which is carried to the country of the Negroes and to Egypt, fifty tons are annually carried to Tripoli. It is not adulterated with salt. The salt-mines are situated on the sea-shore; but the trona occurs twenty-eight days journey up the country *." According to the accounts of Mr Barrow, it would appear also to occur in the district of Tarka, in Boshieman's Land, in Southern Africa.

Uses of Natron.

It is principally employed in the manufacture of glass, and soap, in dyeing, and for the washing of linen. It is sometimes purified before it is used, but more frequently (particularly that from Egypt) it is used in its natural state. In Hungary, particularly at Debrezin, it is used in great quantity in the manufacture of soap: it has also been employed in considerable quantity in Scotland and England for the same purpose. In Siberia, a fine white glass is manufactured with it. In the Levant, the natron

* Bagge, in the Abhandl. d. Schwed. Acad. v. j. 1773, b. xxxv. s. 131.

natron of Suckena is mixed with tobacco, in order to give it a sharper taste. The ancient Egyptians are said to have macerated dead bodies in it for several months previous to preparing them as mummies. It is sometimes also purified for the alkali it contains, and is then used as a flux.

Observations.

1. Klaproth restored to this species the old name *Natron*, a word said to be derived from Nitria in Upper Egypt, where, as already mentioned, it occurs in considerable quantity.

2. The terms *Natrum* and *Nitrum*, which are used indiscriminately by ancient writers, are generally applied to this mineral, sometimes to saltpetre or nitre, and sometimes to sal-ammoniac.

GENUS IX.—BORAX.

THIS Genus contains one species, viz. Prismatic Borax.
* Sassoline.

1. Prismatic Borax.

Borax Tincal, *Wall.* t. ii. p. 82.—Tinkal, *Leonhard,* Tabel. s. 44. *Id. Karsten,* Tabel. s. 56.—Soude boratée, *Haüy,* Tabl. p. 20.—Borax, *Lenz.* b. ii. s. 1024.—Tinkal, *Haus.* Handb. b. iii. s. 840.

External Characters.

Its colours are greyish, yellowish, and greenish-white: also greenish-grey, and mountain-green.

It

Its primitive form is an oblique four-sided prism. The following are some of the secondary crystallizations:

1. Irregular six-sided prism, with alternate broad and narrow lateral planes, and oblique terminal planes.
2. Irregular six-sided prism, with two opposite broader lateral planes: sometimes bevelled on the extremities, the bevelling planes set on the smaller lateral planes. The lateral edges are 91° 50′ and 134° 5′.
3. Irregular eight-sided prism, with lateral edges of 134° 5′ and 135° 55′.
4. Flat four-sided prism, with rhomboidal base.

The surface of the crystals is sometimes smooth, sometimes rough, and covered with a white, grey, or brown crust.

The crystals occur loose, and of various sizes.

Internally it is shining and resinous.

The fracture is partly foliated, partly flat conchoidal.

The fragments are blunt-edged.

It is semitransparent.

It refracts double in a high degree.

It is soft and very soft; brittle and easily frangible.

Specific gravity, 1.569, *Karsten*.—1.705, *Klaproth*.

Its taste is alkaline and sweet.

Chemical Characters.

It intumesces before the blowpipe, and melts into a transparent glass.

Constituent Parts.

Boracic Acid, - -	37.00
Soda, - - - - -	14.50
Water, - - - -	47.00
	98.50

Klaproth, Beit. b. iv. s. 353.

Geognostic

Geognostic and Geographic Situations.

It occurs dissolved in the water of many springs in Persia; also in the soil of different parts of Persia; and in Thibet, it is found in the soil, or in the water of lakes.

It is said also to occur in China, and in the neighbourhood of Escapa in Potosi.

Uses.

It is used as a flux for metals, and as an ingredient in artificial gems; but its great use is to facilitate the soldering of the more precious metals. It is employed as a flux by mineralogists in examining the properties of minerals before the blowpipe; and is sometimes used in medicine as a refrigerant.

Observations.

1. The name *Borax* occurs in Geber, who wrote in the ninth century; and is derived from the word Baurach, in use among the Arabians. It has been confounded with the Chrysocolla of Pliny, in consequence of the use that jewellers make of it in soldering gold. It is brought from India in an impure state, under the name *tinkal*, enveloped in a kind of fatty matter, which is soap with soda for its base. When purified in Europe, it takes the name of *borax*. This purification is performed by the Dutch; but the process which they follow is unknown.

2. Karsten describes, under the name *Sassolin*, a mineral principally composed of boracic acid. The following account contains the principal information we possess in regard to it:

* Sassoline,

* Sassoline, or Native Boracic Acid.

Natürliches Sedativsalz, *Estner*, b. iii. s. 84.—Sassolin, *Reuss*, b. ii. 3. s. 12. *Id. Leonhard*, Tabel. s. 44. *Id. Karsten*, Tabel. s. 56.—Acide boracique, *Hauy*, Tabl. p. 56.

Its colours are greyish and yellowish white, and cream-yellow.

It occurs in grains, crusts, very small corroded pieces, which appear to be composed of crystalline grains, and acicular crystals.

Externally it is uneven.

It is dull or glimmering, and the lustre is resinous.

The fracture passes from uneven into small foliated.

The fragments are blunt-edged.

It is feebly translucent.

It becomes resinous in the streak.

It is soft, and friable.

Chemical Characters.

It melts easily before the blowpipe into a transparent globule.

Constituent Parts.

Boracic Acid, - -	86.0
Ferruginous Sulphate of Manganese, - - -	11.0
Sulphate of Lime, - -	3.0
	100.00

Klaproth, Beit. b. iii. s. 99.

Geognostic and Geographic Situations.

It is found on the edges of hot-springs near Sasso, in the territory of Florence.

CLASS III.

CLASS III.

METALLIC MINERALS.

ORDER I. *NATIVE METALS.*

GENUS I. PLATINA.

THIS Genus contains three species, viz. 1. Native Platina, 2. Palladium, 3. Iridium.

1. Native Platina.

Gediegen Platin, *Werner.*

Platina aurum album, *Wall.* t. ii. p. 365.—Platine, *Romé de Lisle,* t. iii. p. 487. *Id. De Born,* t. ii. p. 479.—Platin, *Werner,* Pabst. b. i. s. 31. *Id. Wid.* s. 661. *Id. Kirw.* vol. ii. p. 109. *Id. Emm.* b. ii. s. 106. *Id. Lam.* t. i. p. 96.—Le Platine natif, *Broch.* t. ii. p. 86.—Platin natif ferrifere, *Haüy,* t. iii. p. 368.—Platin, *Reuss,* b. iii. s. 234. *Id. Lud.* b. i. s. 210. *Id. Suck.* 2ter th. s. 97. *Id. Mohs,* b. iii. s. 3. *Id. Hab.* s. 98.—Platin natif, *Brong.* t. ii. p. 275.—Platin natif ferrifere, *Brard,* p. 234. *Id. Lucas,* p. 101.—Gediegen Platin, *Leonhard,* Tabel. s. 51. *Id. Karsten,* Tabel. s. 60.—Platina, *Kid,* vol. ii. p. 73.—Platin natif ferrifere, *Haüy,* Tabl. p. 72.—Platin, *Haus.* Handb. b. i. s. 97. *Id. Hoff.* b. iii. s. 7.—Native Platina, *Aikin,* p. 74.

External Characters.

Its colour is very light steel-grey, which approaches to silver-white.

It occurs in flat, small, and very small grains, having pretty smooth surfaces; seldom in small angular or roundish grains, with impressions of other minerals.

Externally it is shining, glistening, or glimmering, and the lustre is metallic.

The fracture, on account of the smallness of the particles, cannot be determined. It is probably hackly.

The streak is more shining than the true lustre.

It is intermediate between semi-hard and soft: it is nearly as hard as iron.

It is malleable *.

Specific gravity, 15.601.—18.947, *Tralles.*—17.7, *Wollaston.*—Purified, 23.0, *Thomson.*

Chemical Characters.

It is soluble in the nitro-muriatic acid. It is infusible, without addition, excepting in the focus of a burning-glass, or when exposed to the action of flame urged by oxygen-gas. It is the least fusible of the metals. It does not amalgamate with mercury.

Constituent Parts.

The variety in grains, with a granulated surface, consists of Platina, with a very minute portion of Gold, and of Palladium: the variety in flat and angular grains, consists of Platina,

* It is so ductile, that Dr Wollaston has succeeded in drawing it into a wire $\frac{1}{18750}$ part of an inch in diameter.

Platina, alloyed with small proportions of Iron, Copper, Lead, Palladium, Iridium, Rhodium, and Osmium.

Geognostic and Geographic Situations.

Europe.—Platina has not hitherto been discovered either pure, or forming a principal constituent part of any ore in Europe. The only ore in which it occurs, is the grey silver-ore of Guadalcanal in Spain.

America.—It has never yet been discovered to the north of the Isthmus of Panama, on the continent of North America. Platina in grains is only found in two places in the Spanish South American dominions; in Choco, one of the provinces of the kingdom of New Granada; and near the shores of the South Sea, in the province of Barbacoas, between the 2° and 6° of north latitude. It is peculiar to an alluvial tract of 600 square leagues, where it is associated with grains of native gold, zircon, spinel, quartz, and magnetic ironstone. It is not true that this metal occurs near Carthagena, or Santa Fé, or in the islands of Porto Rico and Barbadoes, or in Peru, although these different localities are mentioned by authors *. The platina in granulated grains is found in alluvial soil, along with grains of gold, in gold-workings in Brazil †.

Uses.

Its property of remaining unaltered in the air, or when exposed to high heats, of resisting the action of many salts, and of receiving a fine polish, have rendered this metal useful for various chemical and physical instruments, as pyrometers.

* Humboldt's New Spain, vol. iii. p. 150. Black's Translation.

† Wollaston, Phil. Trans. for 1809.

rometers, crucibles, pendulums, reflecting telescopic mirrors, and for wheels in the construction of watches. Reflecting mirrors made of glass, although they preserve their lustre and polish well, are inconvenient, because they form a double image: mirrors made with metallic alloys, which were substituted in their place, give but a single image, but tarnish on exposure to the air: mirrors of platina possess the advantage of not tarnishing, and they give but one image, and, owing to their great density, augment the reflecting power. Of all metals it expands the least by heat, and follows the most regular course in its expansion: hence it is admirably fitted for measures. The geometers Delambre and Mechain, in measuring the arc of the meridian contained between Dunkirk and Barcelona, used, in their operations, rods made of this metal. Klaproth has shewn, that it may be used with great advantage in painting and ornamenting porcelain; and although when burnt in and burnished, it has nearly the same colour as silver, yet it is not, like it, liable to be tarnished by sulphureous effluvia, or to be affected by alterations of the atmosphere. The platina used for these purposes is repeatedly melted with arsenic; without its aid, we could only have obtained it in very small masses, owing to the intense heat required for its fusion, and the small quantity fused.

Observations.

1. This mineral is named *Platina*, on account of its silvery aspect, the word being derived from the Spanish *plata*, silver.

2. It is distinguished from *Silver*, by its colour, external shape, greater hardness, and specific gravity.

3. It

3. It is chemically distinguished from *Silver*, by its infusibility without addition, and its insolubility in nitric acid.

4. In the cabinet of the Academy of Bergaria in Biscay, there is said to be a mass of platina, the size of a pigeon's egg *. Humboldt lately presented the King of Prussia with a mass still larger, and which weighs 1088.8 grains, and has a specific gravity of 18.947, according to Professor Tralles.

2. Palladium.

Palladium, *Wollaston*.

Philosophical Transactions for 1809, p. 192.; and *Haus*. Handb. b. i. s. 99.

External Characters.

Its colour is pale steel-grey, passing into silver-white.
It occurs in small grains.
The lustre is metallic.
The fracture is diverging fibrous.
It is opaque.
Specific gravity, 11.8, 12.148 †, *Wollaston*.

Chemical Characters.

It is infusible; but on the addition of sulphur, it melts with ease; by continuance of the heat, the sulphur is dissipated,

* Mr Alaman, a Mexican gentleman, informs me, that there is no specimen of platina of the size mentioned in the text, in the Academy of Bergaria.

† The second specific gravity was communicated to me by Mr Lowry.

pated, and a globule of malleable palladium remains. It forms a deep red solution with nitric acid.

Constituent Parts.

It consists of Palladium, alloyed with a minute portion of Platina, and of Iridium.

Geognostic and Geographic Situations.

It is found in grains, along with grains of native platina, in the alluvial gold districts in Brazil.

Observations.

This mineral was first discovered, described, and analysed by Dr Wollaston.

3. Iridium.

Iridium, *Wollaston.*

Philosophical Transactions for 1805; and *Haus.* Handb. b. i. s. 96

External Characters.

Its colour is very pale steel-grey.
It occurs in very small irregular flat grains.
The lustre is shining and metallic.
The fracture is foliated.
It is brittle.
It is harder than platina.
Specific gravity, 19.5.

Chemical

Chemical Characters.

By fusion with nitre, it acquires a dull black colour, but recovers its original colour and lustre by heating with charcoal.

Constituent Parts.

Iridium is always alloyed with a portion of Osmium.

Geognostic and Geographic Situations.

It occurs in alluvial soil in South America, along with platina.

Observations.

It was first examined, and introduced to the notice of naturalists, by Dr Wollaston.

GENUS II. GOLD.

THIS Genus contains only one species, viz. Hexahedral Gold.

1. Hexahedral Gold.

Hexaedrisches Gediegen Gold, *Mohs.*

Gediegen Gold, *Werner.*

This species is divided into four subspecies, viz. Gold-yellow Native Gold, Brass-yellow Native Gold, Greyish-yellow Native Gold, and Argentiferous Native Gold.

First

First Subspecies.

Gold-yellow Native Gold.

Geld-gelbes Gediegen Gold, *Werner*.

Id. Wern. Pabst. b. i. s. 3. *Id. Emm.* b. ii. s. 111. *Id. Estner,* b. iii. s. 215.—L'Or natif, jaune d'Or, *Broch.* t. ii. p. 89.—Gold-gelbes gediegen Gold, *Reuss,* b. iii. s. 246. *Id. Mohs,* b. iii. s. 11. *Id. Leonhard,* Tabel. s. 51. *Id. Karsten,* Tabel. s. 60. *Id. Haus.* Handb. b. i. s. 101. *Id. Hoff.* b. iii. s. 11.

External Characters.

Its colour is perfect gold-yellow, which varies in intensity; in some varieties it inclines to brass-yellow.

It seldom occurs massive, often disseminated, in membranes, in roundish and flattish pieces, in grains which are large, coarse, small and fine, in leaves, and crystallized, in the following figures;

1. Octahedron.
   a. Perfect.
   b. Truncated on the angles.
   By the increase of these truncating planes, there arises a
2. Cubo-octahedral form, and then the
3. Cube.
   a. Truncated on all the angles.
   b. Truncated on the unconformable and alternate angles.
   c. Perfect.
   d. All the angles very flatly acuminated, with four planes, which are set on the lateral planes.

When

When these acuminating planes become so large that they meet, there is formed a

4. A very acute double eight-sided pyramid, acuminated on each extremity with four planes. It is the Leucite crystal.

By the increase of the truncations on the figure 3. *b.*, there is formed a

5. Tetrahedron.
6. Rhomboidal dodecahedron.

The crystals are generally small and very small, very rarely middle sized, superimposed, and seldom in small druses.

Externally it is shining and splendent, and the lustre metallic.

Internally it is shining and glistening.

The fracture is fine hackly.

The fragments are indeterminate angular, and very blunt-edged.

The streak is shining.

It is soft.

It is uncommonly difficultly frangible.

It is completely malleable, and flexible.

Specific gravity, from 17.000 to 19.000, 13.000 to 18.000, *Haager*.—12.000, *Mohs*.

Chemical Characters.

It is fusible into a globule, which is not altered by continuance of the heat.

Constituent Parts.

It contains only a very minute portion of Silver and Copper.

Geognostic

Geognostic Situation.

It occurs disseminated, in veins, and mineral beds, in granite, gneiss, mica-slate, clay-slate, clay-porphyry, and sandstone; also in grains and masses in alluvial deposites, in the beds of rivers, or in the alluvial soil in the flat country through which rivers occasionally flow. It is generally associated with quartz and iron-pyrites, and frequently also with yellow blende, brown iron-ochre, calcareous-spar, and heavy-spar. Its other accompanying minerals are felspar, hornstone, red silver, brittle silver-glance, copper-pyrites, copper-green, variegated copper-ore, malachite, brown iron-ore, galena or lead-glance, red lead-spar, blende, grey antimony, white cobalt, copper-nickel, arsenical-pyrites, and orpiment.

Geographic Situation.

Europe.—It is found in alluvial soil in the mining field of Leadhills. In the time of Queen Elizabeth, extensive washings were carried on in that district, for the purpose of collecting this precious metal; and it is reported that three hundred men were employed in searching for it, and that in the course of a few summers a quantity was collected equal in value to £100,000 Sterling. It also occurs in Glen Turret in Perthshire *; in stream-works in Cornwall; and in a ferruginous sand near Arklow, in the county of Wicklow, where a mass weighing twenty-two ounces, the largest piece hitherto met with in Europe, was found †. It occurs

* I am informed that gold has been found at Cumberhead in Lanarkshire.

† The sand of any river is worth washing for the gold it contains, provided it will yield twenty-four grains in a hundred weight; but the sand of the

occurs in granite at Gasten in Salzburg; at Gardette in France; in gneiss in Upper Hungary; in mica-slate in Salzburg and the Tyrol; in clay-porphyry in Transylvania; in hornblende rock along with auriferous iron-pyrites, in veins of quartz, at Edelfors in Sweden. Rich mines of gold were formerly worked in Spain, and the most important of these were situated in Gallicia, where the gold occurred in regular veins. These mines, according to Diodorus Siculus, were worked by the Phœnicians, and afterwards by the Romans, who derived great wealth from them. The island of Thasos in the Mediterranean was celebrated for its mines of gold; and Thrace and Macedonia afforded much gold to the ancients. The sands of the Danube, Rhine, Rhone, Tagus, and many other European rivers, afford gold, and have been at different periods washed for this metal.

Asia.—There are few considerable mines of gold at present worked in this quarter of the globe. In Siberia, native gold occurs at Schlangenberg, in veins that traverse hornblende rock: auriferous pyrites is met with in quartz at Beresof, in the same country. In the southern parts of Asia, the sands of many rivers afford gold. The Pactolus, a small river in Lydia, formerly afforded so much gold, that it is alleged to have been one of the chief sources of the riches of Crœsus. The numerous islands in the Indian ocean, as Java, Japan, Formosa, Borneo, and the Philippines, afford considerable quantities of gold.

In the island of Sumatra, 15,400 ounces of gold are collected annually. It is obtained, either from veins, where it

the African rivers often yield sixty-three grains in not more than five pounds weight; which is in the proportion of fifty times as much.—*Kid*, vol. ii. p. 76.

it is associated with quartz, or from alluvial soil, where it occurs in the form of dust, or in masses that sometimes weigh upwards of nine ounces *.

There are considerable mines of gold in Cochinchina, of which the most important are those in the provinces of Cham and Naulang, where the gold occurs in dust or grains, and in pieces that sometimes weigh fully two ounces. Gold-mines are also worked in the kingdom of Siam.

Africa.—This continent affords a considerable quantity of gold, which is always obtained in the form of dust or rolled masses, which is found in the sand of rivers, or the alluvial soil of valleys or plains. The northern parts of Africa afford but little gold, but in the middle and southern regions, there are several tracts remarkable for the quantity of gold they afford. The first is Kardofan, situated between Darfur and Abyssinia. The gold collected there, is brought to market by the Negroes in quills of the ostrich and vulture. This territory, it would appear, was known to the ancients, who regarded Æthiopia as a country rich in gold.

The second principal tract lies to the south of the great Desart of Zara, and in the western part of Africa. The gold is collected in that extensive flat which stretches from the foot of those mountains in which are situated the sources of the rivers Gambia, Senegal, and Niger. Gold is also found in the sands of all these rivers. Bambouck, which is situated to the north-west of these mountains, furnishes the greatest part of the gold which is sold on the western coast of Africa, as well as that which is brought to Morocco,

* Marsden's Sumatra, p. 165,—172. 3d edition.

rocco, Fez, Algiers, and to Cairo and Alexandria in Egypt.

The third principal tract where gold is abundant, lies on the south-east coast, between 15° and 22° of south latitude, and nearly opposite Madagascar. The gold of that country, it is said, is found not only in the state of dust, but also in veins; and it is supposed, that Ophir, from which Solomon obtained gold, was a country on the same coast. Nearer to the equator, the Gold Coast supplied the Portugueze, and afterwards the Dutch, with great quantities of gold dust *.

America.—In modern times, this continent is considered the richest country of the world in gold. There the gold is chiefly collected in alluvial soil, and in the beds of rivers, and sometimes also from veins. In Mexico, the gold is for the most part extracted from alluvial soil by means of washing; and the particles vary in size, from that of dust to the weight of from five to six pounds. Another part of the Mexican gold is extracted from veins which traverse primitive mountains. The veins of native gold are most frequent in the province of Oaxaca, either in gneiss or mica-slate. This last rock is particularly rich in gold, in the celebrated mines of Rio San Antonio. These veins are about a foot and half wide, and contain besides the gold common quartz. The same metal occurs, either pure, or mixed with silver-ore, in the greatest number of veins that have been wrought in Mexico; and there is scarcely a single silver-mine which does not also contain gold.

On the coast of California, there is a plain of fourteen leagues in extent, covered with an alluvial deposite, in which lumps of gold are dispersed.

In

* Brongniart's Mineralogie, t. ii. p. 271, 272, 273.

In the kingdom of New Granada in South America, gold is found in considerable quantity. It is obtained by the washing of the alluvial deposites in which it is contained. Gold veins have been found in the mountains of Guamoco and Antioquia, but their working is almost entirely neglected. The greatest riches in gold obtained by washing, are deposited to the west of the central Cordillera, in the provinces of Antioquia and Choco, in the valley of the Rio Cauca, and on the coast of the South Sea, in the *Partido de Barbacoas*. The alluvial grounds which contain the greatest quantity of gold in dust and grains, disseminated among fragments of greenstone and porphyry-slate, extend from the western Cordilleras almost to the shores of the South Sea.

The province of Antioquia, into which we can only enter on foot, or on the shoulders of men, contains veins of gold in mica-slate, also wash-gold, or gold-dust, as it is sometimes called, in alluvial deposites.

The largest piece of gold ever found in Choco, weighed 25 lb. It is said that a piece of gold was found in Peru, near La Paz, in the year 1730, of the weight of 45 lb.

Humboldt, to whom we are indebted for the preceding particulars in regard to the gold of Spanish America, informs us, that the total annual produce of the gold-mines of the Spanish American colonies, amounts to 25,026 lb Troy.

A very considerable proportion of the gold of commerce comes from the Portugueze possessions in the Brazils. In that country, it is collected by washing from the sand of rivers, and the other alluvial deposites. Gold is found almost every where throughout that vast country, along the foot of the immense chain of mountains which lies nearly

parallel

parallel with the coast, and extends from 5° to 30° of south latitude. From this country nearly 30,000 marcs of gold are annually exported to Europe; so that the total produce of gold from the Spanish and Portugueze colonies in the Americas, may be stated at 45,580 lb. Troy *.

A considerable quantity of gold has been of late years collected in North Carolina. It is there found in alluvial land.

It would appear from the preceding statement, that most of the gold of commerce comes from America and Africa, and that by far the greatest proportion of this is collected from an alluvial land, which is frequently ferruginous. The only considerable gold-mines in Europe, are those of Hungary, but the gold is principally the brass-yellow subspecies.

Second Subspecies.

Brass-yellow Native Gold.

Messing-gelbes gediegen Gold, *Werner.*

Id. Werner's Pabst. b. i. s. 5. *Id. Emm.* b. ii. s. 113.—L'Or natif d'un jaune de Laiton, *Broch.* t. ii. p. 91.—Messing-gelbes

* If we understand correctly the accounts given by early writers, the quantity of gold amassed by the ancients must have been prodigious. Thus, in the 1st Book of Kings, chap. x. ver. 14. we are told, that King Solomon received 666 talents of gold (more than 27 tons weight, according to the usual mode of estimating the talent,) in one year; and in the 21st verse of the same chapter, it is said, " And all King Solomon's drinking vessels were of gold, and all the vessels of the forest of Lebanon were of pure gold: none were of silver; it was nothing accounted of in the days of Solomon." Diodorus says, that the tomb of King Simandius was environed

gelbes gediegen Gold, *Reuss*, b. iii. s. 258. *Id. Mohs*, b. iii. s. 16. *Id. Leonhard*, Tabel. s. 51. *Id. Karsten*, Tabel. s. 60. *Id. Haus.* Handb. b. i. s. 101. *Id. Hoff.* b. iii. s. 15.

External Characters.

Its colour is brass-yellow, of every degree of intensity.

It occurs disseminated, rarely massive, capillary, moss-like, reticulated, and in leaves; also crystallized in the following figures:

1. Octahedron.
2. Six-sided table, in which the terminal planes are set on alternately straight and oblique.

Specific gravity 12.713, *Karsten.*

Constituent Parts.

	Eula in Bohemia.
Gold, - - -	96.9
Silver *, - - -	2.0
Iron, - - - -	1.1
	100

Lampadius, Handbuch zur Chem
Annal. d. Min. 251.—253.

Geognostic

environed with a circle of gold three hundred and fifty cubits about, and a foot and a half thick. Semiramis erected in Babylon three statues of gold, one of which was forty feet high, and weighed a thousand Babylonian talents. For these statues there was a table or altar of gold forty feet long, and twelve feet broad, weighing fifty talents.

* It is probable that this subspecies contains more silver than appears from the analysis of Lampadius.

Geognostic and Geographic Situations.

This mineral is found in the gold-mines of Hungary, Transylvania, Bohemia, and Siberia, and in many other situations where the gold-yellow subspecies occurs. It is said to be the most frequent native gold of Europe. It generally occurs in small veins in porphyry and grey-wacke. The minerals with which it is most frequently associated in these veins, are native silver, silver-glance, brittle silver and red silver, iron-pyrites, and quartz. Besides these, the following also occur, viz. copper-pyrites, grey copper, copper-glance, variegated copper, and copper-green; almost the only iron-ores are brown iron-ore; the species of zinc are yellow and brown blende; of lead, lead-glance or galena, and green lead-spar; traces of copper-nickel, and white cobalt; native arsenic, arsenical-pyrites, and red orpiment. Besides quartz, the following earthy minerals are met with in these veins, viz. brown-spar, calcareous-spar, heavy-spar, selenite, common garnet, and lithomarge.

Third Subspecies.

Greyish-yellow Native Gold,

Graugelbes gediegen Gold, *Werner.*

Id. Emm. b. ii. s. 114.—L'Or natif d'un jaune grisatre, *Broch.* t. ii. p. 92.—Fahlgelbes gediegen Gold, *Reuss,* b. iii. s. 260. —Graugelbes gediegen Gold, *Leonhard,* Tabel. s. 51. *Id. Karsten,* Tabel. s. 60. *Id. Hoff.* b. iii, s. 17.

External Characters.

Its colour is brass-yellow, which verges on steel-grey.

It occurs in very small flattish grains, like those of platina.

Its surface is glistening.

It is never crystallized.

It is heavier than brass-yellow native gold, but lighter than gold-yellow native gold.

In other characters it does not differ from the preceding.

Constituent Parts.

It is said to contain Platina.

Geognostic and Geographic Situations.

It occurs, along with platina and magnetic iron-ore, in South America.

Uses.

The numerous and important uses of this metal, will be considered in another work. We may here only remark, that for whatever purpose gold is used, it is mixed with a quantity of copper, which is usually about $\frac{1}{21}$, and never exceeds $\frac{1}{4}$, which gives the gold a consistence and a hardness it does not possess when pure.

Observations.

Iron-pyrites is sometimes auriferous, but the richest varieties at Facebay in Transylvania, do not afford more than 0.02 to 0.03 of gold. Auriferous pyrites is also met with at Adelfors in Smoland in Sweden, in the Valais and Grisons

in

in Switzerland, in Dauphiny, Siberia, and Mexico. This variety is distinguished from copper and iron-pyrites, by colour, specific gravity, and malleability.

Fourth Subspecies.

Argentiferous Gold, or Electrum.

Electrum, *Klaproth.*

Electrum, *Plin.* Hist. Nat. xxxiii. cap. iv. § 23.—Natürliches Electrum, v. *Veltheim's* Grundriss einer Mineralogie Braunscher, 1781, fol. 11.—Elektrum, *Klap.* b. iv. s. 1.—Argentiferous Native Gold, *Aikin,* p. 76.

External Characters.

Its colour is pale brass-yellow, passing into silver-white.

It occurs in small plates, dentiform, and in imperfect cubes.

The other characters are not stated by Klaproth, to whom we are indebted for what is known of this mineral.

Chemical Characters.

It is not soluble either in nitrous or nitromuriatic acids.

Constituent Parts.

Gold, - - - -	64
Silver, - - - -	36
	100

Klaproth, Beit. b. iv. s. 3

Geognostic and Geographic Situations.

It occurs, along with massive heavy-spar, or ash-grey splintery hornstone, at Schlangenberg in Siberia.

Observations.

1. The ancients applied the name *Electrum*, not only to amber, but also to a particular mixture of gold and silver, as appears from the following passage of Pliny: " *Omni auro inest argentum vario pondere. Ubicunque quinta argenti portio est,* electrum *vocatur* *." Hence Klaproth applies the name Electrum to this mineral.

2. As this mineral is not acted on, either by nitrous or nitro-muriatic acid, it follows, that the gold and silver are more than mechanically mixed.

Genus III. SILVER.

This genus contains one species, viz. Hexahedral Silver.

1. Hexahedral Silver.

Hexaedrisches Silber, *Mohs.*

This species is divided into two subspecies, viz. Common Native Silver, and Auriferous Native Silver.

First

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* Plin. Hist. Nat. Lib. xxxiiii cap. iv. § 23.

First Subspecies.

Common Native Silver.

Id. Wern. Pabst. b. i. s. 12. *Id. Estner,* b. iii. s. 319. *Id. Emm.* b. ii. s. 156.—L'Argent natif ordinaire, *Broch.* t. ii. p. 116.—Argent natif, *Haüy,* t. iii. p. 384.—Gediegen Silber, *Reuss,* b. iii. s. 310.—Gemeiner gediegen Silber, *Lud.* b. i. s. 210. *Id. Suck.* ter th. s. 129. *Id. Bert.* s. 360. *Id. Mohs,* b. iii. s. 102. *Id. Hab.* s. 102.—Argent natif, *Lucas,* p. 103.—Gemeiner gediegen Silber, *Leonhard,* Tabel. s. 53.—Argent natif, *Brong.* t. ii. p. 248. *Id. Brard,* p. 240.—Gediegen Silber, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 69.—Native Silver, *Kid,* vol. ii. p. 83.—Argent natif, *Haüy,* Tabl. p. 73.—Gediegen Silber, *Haus.* Handb. b. i. s. 105. *Id. Hoff.* b. iii. s. 39.—Native Silver, *Aikin,* p. 70.

External Characters.

Its colour is pure silver-white; but the surface, by exposure to the air, becomes yellowish-brown, or brownish-black.

It seldom occurs massive, more frequently disseminated, in blunt-cornered pieces, in plates, and in membranes: it is said also to occur in Spanish America in rolled pieces *. Besides these, it presents the following particular and regular external shapes: dentiform, filiform, reticulated, in leaves, capillary, which latter, when it is very much entangled, passes into compact. The crystallizations are the following:

1. Cube †.

2. Cube.

* In the Imperial Cabinet of minerals at Vienna, there is a rolled piece of native silver from Spanish America, which weighs upwards of 36 pounds.

† Argent natif cubique, Haüy.

2. Cube, truncated on the angles *.
3. Octahedron, either common or cuneiform †, and sometimes truncated on all the edges.
4. Tetrahedron.
5. Rhomboidal dodecahedron.
6. Leucite form.
7. Six-sided table, in which the terminal planes are set on alternately straight and oblique, and are bevelled.

The crystals are small and very small, and microscopic.

The surface of the crystals is smooth; that of the particular shapes longitudinally streaked; that of the external shapes in leaves is sometimes drusy, sometimes streaked.

The surface varies from splendent to glimmering, according to the kind of surface; that of the crystals being splendent and shining; of the particular and common external shapes glistening and glimmering, with a metallic lustre.

The fracture is fine hackly.

The fragments are indeterminate angular, and blunt-edged.

The streak is splendent, with metallic lustre.

It is harder than gold, tin, or lead; but softer than iron, platina, and copper.

It is perfectly malleable.

It is flexible, and difficultly frangible.

Specific gravity, 10.4743, *Haüy*.—10.000, *Gellert*.—10.338, *Selb*.—10, 10.4, *Mohs*.

Chemical

* Argent natif cubo-octaedre, Haüy.

† Argent natif octaedre, Haüy.

Chemical Characters.

It is soluble in nitric acid at the common temperature of the atmosphere; but the sulphuric acid does not act on it until heated. It is precipitated from its solution in nitric acid by muriatic acid; and the precipitate, which is *luna cornea*, is insoluble in water; if a plate of copper be immersed in a solution of nitrate of silver, the silver is deposited, in its metallic state, on the surface of the copper. It is fusible into a globule, which is not altered by continuance of the heat.

Constituent Parts.

Native Silver from Johanngeorgenstadt.

Metallic Silver, -	99
Metallic Antimony, -	1
With a trace of Copper and Arsenic.	
	100

John, Chem. Untersuchungen, b. i. s. 283.

Geognostic Situation.

It occurs principally in veins in primitive mountains. In Suabia, and in some places in the Saxon Erzgebirge, it occurs in granite; in gneiss, and mica-slate, in Saxony, Bohemia, and Norway; in clay-slate in Ireland, Saxony, and Bohemia; in syenite and porphyry in Saxony and Hungary; and in primitive trap in Norway. In veins in transition rocks, as in grey-wacke in the Hartz. In flœtz rocks, as in clay-porphyry at Alva, in the Ochil Hills; and in other districts in limestone, sandstone, clay-stone, and slate-clay.

clay. The native silver in these rocks is accompanied with various metalliferous and earthy minerals. The following are the principal metalliferous minerals, viz. corneous silver, silver-glance or sulphuretted silver, brittle silver-glance or brittle sulphuretted silver, red silver; also antimonial and arsenical silver, native arsenic, white cobalt, red cobalt, copper-nickel, and native bismuth; further, galena or lead-glance, black and brown blende, copper-pyrites, iron-pyrites, brown iron-ore, native mercury, &c. The following are some of the earthy minerals, viz. heavy-spar, brown-spar, calcareous-spar, fluor-spar, quartz, horn-stone, flint; and less frequently asbestus, steatite, apatite, &c.

Geographic Situation.

Europe.—Many years ago, a vein of silver was, for a short time, wrought with considerable advantage in the parish of Alva, in the county of Stirling. The metalliferous minerals were, native silver, and silver-glance, with ores of copper and cobalt; and the vein-stones were calcareous-spar and heavy-spar. It is said, that from £ 40,000 to £ 50,000 worth of silver was extracted from the ores, before the repositories were exhausted. We are told, that a mass of capillary native silver was found in the veins traversing the blue-coloured limestone of the island of Isla. Native silver has also been met with at St Mewan, St Stephen's, Huel-Mexico, and Herland, in Cornwall *. The most northern silver-mines in Europe, are those of Kongsberg

* In the second volume of the Transactions of the Geological Society, it is mentioned, that the native silver in Cornwall is associated with galena or lead-glance, iron-pyrites, bismuth, cobalt, and wolfram, in veins traversing clay-slate.

berg in Norway. The predominating rocks of the district, which are mica-slate and hornblende-slate, are traversed by numerous veins containing native silver, silver-glance or sulphuretted silver, also native gold, auriferous silver, red silver, corneous silver, galena, native arsenic, brown blende, copper-pyrites, and iron-pyrites. The most abundant and frequent vein-stones are calcareous-spar and heavy-spar. In former times, these mines afforded uncommonly beautiful and large specimens of native silver. In the year 1628, a mass of pure silver, weighing 68 lb. was met with in the mine Segen Gottes, and in the year 1630, in the same mine, one of 204½ lb. In the year 1666 a mass of silver weighing 560 lb., and which is still preserved in the Royal Collection at Copenhagen, was dug out of the mine named Nye-Forhaabing. In the year 1695, the mine Neue Juels afforded a mass weighing upwards of 118 lb.; and in the year 1769, in the mine Gottes Hülfe in der Noth, a mass estimated at 500 lb. was extracted from one of the veins *. Native silver is also found at Sala, in Westmaunland in Sweden; and in the mines in the Hartz, in small quantity, along with galena and calcareous-spar. In the kingdom of Saxony, as in the district of Freyberg, it occurs in veins, associated with various ores of silver, arsenic, iron, lead, and nickel, along with calcareous-spar, heavy-spar, fluor-spar, and quartz, in veins that traverse gneiss. The masses are sometimes of great magnitude: thus, we are told, that in 1750, a mass of native silver, weighing upwards of 1¼ cwt. was dug out of the great mine named Himmelsfurst, situated within a few miles of Freyberg. It is also mentioned by

* Hausmann's Reise durch Scandinavien in den Jahren 1806 & 1807, b. ii. s. 18.

by Albini, in his "Meissnische Berg-Chronicke," p. 30. that at Schneeberg, in the year 1478, a rich silver vein was discovered, and so large a block of native silver and ore cut out, that Duke Albert of Saxony descended into the mine, and used this huge block, which smelted 400 centners of silver, (a centner is 110 lb.), as a table to dine on. Native silver also occurs in Bohemia, in veins in clay-slate, along with galena or lead-glance, blende, silver-glance, cobalt, nickel, sparry iron, iron-pyrites, quartz, and calcareous-spar. At Rudelstadt in Silesia, along with red silver, quartz, calcareous-spar, and lamellar heavy-spar. At Furstenberg in Suabia, in calcareous-spar, with quartz, and lamellar heavy-spar. At Wittichen, also in Suabia, in granite, along with black cobalt-ochre, white cobalt, seldom with native bismuth, red silver, and iron-glance. At Reinerzau in Wirtemberg, along with silver-glance, and red silver, and ores of cobalt, bismuth, copper, iron, and manganese; and the vein-stones are lamellar heavy-spar, and fluor-spar: in the mine named Herzgol Frederick, in the same country, it is associated with uran-mica, and lamellar heavy-spar, and fluor-spar. At Allemont in France, it occurs in veins, along with silver-glance, red silver, corneous silver, ores of cobalt, native antimony, and nickel; and the vein-stones are calcareous-spar, mixed with asbestus and epidote. At Guadalcanal in Spain, along with red silver, and calcareous-spar. At Felsobanya in Hungary, along with native gold and iron-shot quartz. At Schemnitz, with white and brown lead spars, native gold, brittle silver-glance, and quartz; and in other mines, also in Hungary, associated with silver-glance, brittle silver-glance, red manganese, brown-spar, and calcedony. At Kapnick in Transylvania, with silver-glance, red silver, blende, brown-spar, and quartz.

Asia.

Asia.—Native silver is collected in several parts of Siberia: thus, at Kolywan, in the mine of St Andreas, it occurs disseminated in hornstone, along with brittle silver-glance; at Schlangenberg, in various forms, along with blue copper; at Nertschinsk, with copper-green, and heavy-spar. It is said to be mined in China; and it is known to occur at Pondang in Java.

North America.—The silver-mines of Mexico and Peru have long been celebrated. Most of the Mexican silver is obtained from silver-glance or sulphuretted silver, grey copper, corneous silver, red silver, argentiferous galena or lead-glance, and argentiferous iron-pyrites. In some parts of Mexico, however, as we are informed by M. Humboldt, the operations of the miner are directed to a mixture of ochry brown iron-ore, and minutely disseminated native silver. This ochreous mixture, which is named *pacos* in Peru, is the object of considerable operations at the mines of Angangueo, in the intendancy of Valladolid, as well as of Yxtepexi, in the province of Oaxaca*. Massive native silver, which is much less abundant in America than is generally supposed, has been found in considerable masses, sometimes more than 444 lb. avoirdupois, in the veins of Batopilas in New Biscay. These mines, which are not very actively worked at present, are amongst the

* The Pacos, according to Klaproth, contains the following ingredients:

Silver,	14.00
Brown Oxide of Iron,	71.00
Silica	3.50
Sand, &c.	1.00
Water,	8.50
	98.00

Klaproth, Beit. b. iv. s. 9.

the most northern of Mexico. Nature exhibits the same minerals there, that are found in the silver-mines of Kongsberg in Norway. Native silver is constantly accompanied by silver-glance or sulphuretted silver, in the veins of Mexico as well as in those of the mines of Europe. These very minerals are frequently found united, in the rich mines of Sombrerete, Madrona, Ramos, Zacatecas, Hapujaha, and Sierra de Penos. From time to time, small branches or filaments of native silver are also discovered in the celebrated vein of Guanaxuato; but these masses have never been so considerable as those which were formerly drawn from the mine Del Encino, near Pachuca and Tasco, where native silver is sometimes contained in selenite. At Sierra de Pinos, near Zacatecas, native silver is accompanied with radiated blue copper.

Dr Schumacher informs us, that a Mr Ginge, a missionary, brought from West Greenland a specimen of capillary native silver, associated with calcareous-spar, and which, he says, was picked up on the shores of that country *.

South America.—The mines of Huantajaya, surrounded with beds of rock-salt, are particularly celebrated, on account of the great masses of native silver which they contain in a decomposed vein; and they furnish annually between from 45,942 to 52,505 lb. Troy of silver. The native silver is accompanied with conchoidal corneous silver, silver-glance or sulphuretted silver, galena or lead-glance, with small grains of quartz, and calcareous-spar. In 1758 and 1789, two masses of native silver were discovered in the mines of Coronel and Loysa, the one weighing eight, the other

* Verzeichniss der Danish-Nordischen Mineralien, p. 147.

other two quintals. The mines of Gualgayoc and Micuipampa, commonly called Chota, also in South America, afford native silver.' Immense wealth, M. Humboldt remarks, has been found even at the surface, both in the mountain of Gualgayoc, which rises like a fortified castle in the midst of the plain, and at Fuentestiana, at Caromolache, and at La Pampa de Navar. In this last plain, for an extent of more than half a square league, wherever the turf has been removed, silver-glance has been extracted, and filaments of native silver adhere to the roots of the gramina. Frequently the silver is found in masses, as if melted portions of this metal had been poured upon a very soft clay. The mines of Gualgayoc have furnished to the treasury of Truxillo, between the month of April 1774 and the month of October 1802, the sum of 1,189,456 lb. Troy of silver; or at an average 44,095 lb. annually.

The mines of Pasco afford native silver, along with ores of this metal, and afford annually from 131,263 lb. Troy to 196,894 lb. Troy of silver.

Mr Helms is of opinion, that the Cordilleras of America, when properly investigated, will afford so great a quantity of silver, as to overturn our present commercial system,—by making silver as common as copper and iron.

Uses.

Its various uses, in coinage, and for other useful and ornamental purposes, will be considered in a separate work.

Observations.

Native silver is distinguished from *Antimonial Silver*, and *Native Antimony*, by fracture and tenacity: it has a hackly

hackly fracture, and is completely malleable; but they are brittle, and have a foliated fracture.

Second Subspecies.

Auriferous Native Silver.

Guldisches gediegen Silber, *Werner.*

Id. Werner, Pabst. b. i. s. 12. *Id. Estner,* b. iii. s. 315. *Id. Emm.* b. ii. s. 154.—L'Argent natif aurifere, *Broch.* t. ii. p. 114.—Guldisch Silber, *Reuss,* b. iii. s. 332. *Id. Lud.* b. i. s. 210. *Id. Suck.* 2ter th. s. 128. *Id. Bert.* s. 362. *Id. Mohs,* b. iii. s. 123. *Id. Leonhard,* Tabel. s. 53. *Id. Karsten,* Tabel. s. 60. *Id. Haus.* Handb. b. i. s. 104. *Id. Hoff.* b. iii. s. 44.

External Characters.

Its colour is intermediate between brass-yellow and silver-white.

It occurs disseminated, in membranes, which are pretty thick, in leaves, and sometimes crystallized in cubes.

Its specific gravity, on account of the quantity of gold which it contains, is greater than that of common native silver.

In other characters, it agrees with the preceding species.

Constituent Parts.

Silver,	-	-	72.00
Gold,	-	-	28.00
			100.00

Fordyce, Phil. Trans. 1779, p. 523.

Geognostic

Geognostic and Geographic Situations.

It occurs in veins in primitive rocks at Kongsberg in Norway; at Rauris in Salzburg; and at Schlangenberg in Siberia.

GENERAL OBSERVATIONS ON SILVER *.

1. The most valuable silver mines in the Old World are situated in the Austrian dominions, consequently including those of Bohemia, Hungary, Transylvania, Salzburg, Moravia, and Austria: the next in importance are those of Russia and Saxony; and less considerable are the Hanoverian, Prussian, Bavarian, and Swedish mines. In the New World, the silver-mines of Mexico and Peru far exceed in value the whole of the European and Asiatic mines; for we are told by Humboldt, that these mines, in the space of three centuries, afforded 316,023,883 lb. Troy of pure silver †. Humboldt also states the quantity of gold and silver imported into Europe from America, between the years 1492 and 1803, at £1,166,775,322 Sterling, and gives the following table of the annual produce of the gold and silver mines of Europe, Northern Asia, and America.

ANNUAL

* The silver of commerce is principally obtained from silver-glance, red silver, and lead-glance.

† Humboldt remarks, that this silver would form a solid sphere of rather more than 91 English feet.

ANNUAL PRODUCE of the Gold and Silver Mines of Europe, Northern Asia, and America.

Great Political Divisions.	Gold.				Silver.				Value of Gold and Silver in Piastres.	Value of Gold and Silver in Sterling money.
	Marcs of France.	Killogr.	Value in Francs.	Value, Sterling money.	Marcs of France.	Killogr.	Value in Francs.	Value, Sterling money.		
Europe, -	5,300	1,297	4,467,444	£ 178,697	215,200	52,670	11,704,444	L. 468,177	16,171,888	L. 646,874
Northern Asia,	2,200	538	1,853,111	74,124	88,700	21,709	4,824,222	192,966	6,677,333	267,090
America,	70,647	17,291	59,557,889	2,382,315	3,250,547	795,581	176,795,778	7,071,830	236,353,667	9,454,145
Total,	78,147	19,126	65,878,444	£ 2,635,136	3,554,447	869,960	193,324,444	£ 7,732,973	259,202,888	£ 10,368,109

2. The relative value of gold and silver, as will appear from the following statement, has varied considerably at different times. According to the present regulations in the British mint, a pound of standard gold is coined into $44\frac{1}{2}$ guineas: a pound weight of standard silver is coined into 62 shillings; and a guinea is current for 21 shillings. These particulars enable us to calculate the relative value of gold to silver, if we neglect the alloy in the coins; for $44\frac{1}{2}$ guineas are equivalent in value to 1869 sixpences, and 62 shillings being equal to 124 sixpences, the value of gold is to that of silver as 1869 to 124, or as $15\frac{9}{124}$ to 1 *. This would accurately express the relative values of the two metals, if the quantity of alloy in a pound weight of standard in each bore the same proportion to the whole, which however is not the case. In a pound weight of standard gold at the British mint, one-twelfth is alloy; in a pound weight of standard silver, it is $\frac{3}{40}$; and the relative value of pure gold to pure silver, according to these regulations, and the established currency between coins of the two metals, is as 15 [illegible] to 1. One of the earliest accounts of the relative value of gold and silver we possess, is that of Herodotus, who informs us, that in Persia and Greece, it was as 13 to 1. Plato, who flourished about fifty years after Herodotus, asserts, in his Hipparchus, that the value of gold in Greece was to that of silver as 12 to 1 †. Menander, who was born about the year 341 before the Christian era, estimates the value of gold to that of silver so low as 10 to 1. According to Pliny, the relative value of the two metals in Rome, was at one period as high as $14\frac{1}{2}\frac{3}{8}$ to 1; but this did not continue long;

* This is applicable to the state of matters before the late coinage of 1817.

† Platonis Opera, t. iii. p. 231. edit. H. Steph. 1578.

long; for we find, in the conditions on which the Romans made peace with the Ætolians, about 189 years before the Christian era, that they coincided with the Greeks in estimating the value of gold to be to that of silver as 10 to 1. On the return of Cæsar to Rome from Gaul, he brought with him so much gold, that the value of that metal to that of silver was soon as low as 7½ to 1. We cannot say how long this last-mentioned proportion between the two precious metals continued; but we find, that in the time of Claudius, about a century after Cæsar's return from Gaul, the value of gold was considerably advanced; for under this Emperor's reign, it was thought proper, according to Tacitus * and the younger Pliny †, to limit the fee of an advocate to 10,000 sesterces, and this legal fee is stated in the Digest at 100 aurei. Now, as 10,000 sesterces were equal to 2,500 denarii, it follows, that the value of gold was to that of silver as 2,500 to 200; or as 12½ to 1. It is highly probable that this proportion continued some time after the reign of Alexander Severus, as the state of the Empire justifies such a supposition. At what period it ceased cannot be determined; but under the reign of Constantine the Great, we find, that the value of gold was much diminished, the proportion being now as 10½ to 1. Owing to the political alterations which succeeded the reign of Constantine, the value of gold was much increased: even so soon as the time of Arcadius and Honorius, about sixty years after Constantine, the proportional value of the metals was as 14$\frac{2}{5}$ to 1.

From this statement, it appears, that the lowest proportional value of the two metals in ancient times, was as 7½ to 1, and the highest as 14$\frac{2}{5}$ to 1; which latter does not differ

* Tacitus, Annalium, lib. xi. cap. 7.

† C. Plinii Epist. lib. v. ep. 25.

differ much from that which exists at present. The various causes which gave rise to these fluctuations, are luminously detailed in Lord Liverpool's valuable "Letter to the King on the Coins of the Realm."

Genus IV. MERCURY.

This Genus contains two species, viz. 1. Fluid Mercury, 2. Dodecahedral Mercury.

1. Fluid Native Mercury.

Tropfbares Gediegen Quecksilber, *Mohs.*

Gediegen Quecksilber, *Werner.*

Argentum vivum, *Plin.* Hist. Nat. xxxiii.—Mercurius virgineus; Hydrargyrum nativum, *Wall.* t. ii. p. 148.—Mercure natif, *Romé de Lisle*, t. iii. p. 152.—Gediegen Quecksilber, *Wid.* s. 719. *Id. Wern.* Pabst. b. i. s. 6.—Native Mercury, *Kirw.* vol. ii. p. 223.—Gediegen Quecksilber, *Emm.* b. ii. s. 129.—Mercure natif, *Lam.* t. i. p. 166. *Id. Broch.* t. ii. p. 96. *Id. Haüy*, t. iii. p. 423.—Gediegen Quecksilber, *Reuss*, b. iii. s. 269. *Id. Lud.* b. i. s. 205. *Id. Suck.* 2ter th. s. 109. *Id. Bert.* s. 432. *Id. Mohs*, b. iii. s. 93.-96.—Mercure natif, *Lucas*, p. 109.—Gediegen Quecksilber, *Leonhard*, Tabel. s. 51.—Mercure natif, *Brong.* t. ii. p. 241. *Id. Brard*, p. 253. Gediegen Quecksilber, *Karsten*, Tabel. s. 60. *Id. Haus.* s. 69.—Native Quicksilver, *Kid*, vol. ii. p. 93.—Mercure natif, *Haüy*, Tabl. p. 77.—Gediegen Quecksilber, *Haus.* Handb. b. i. s. 108. *Id. Hoff.* b. iii. s. 18.—Native Quicksilver, *Aikin*, p. 81.

External Characters.

Its colour is pure tin-white.

It occurs perfectly fluid; and in larger or smaller particles or globules in the cavities of ores of mercury.

It is splendent, and the lustre is metallic.

It does not wet the finger.

It is opaque.

It feels very cold.

Specific gravity, in its fluid state, 13.581, *Haüy.*—When solid, 15.61, *Biddle.*—12.0, 14.0, *Mohs.*

Chemical Characters.

It volatilises entirely before the blowpipe, at less than a red heat.

Constituent Parts.

According to Klaproth, it contains no intermixture of any other metal.

Geognostic Situation.

This mineral occurs principally in rocks of the coal formation, and either disseminated, or in veins traversing them. It is associated with cinnabar, corneous mercury, and dodecahedral native mercury, and often also with iron-pyrites, heavy-spar, calcareous-spar, and quartz. Small veins of it are rarely met with in primitive rocks, as mica-slate and clay-slate, where it is accompanied with native silver, grey manganese-ore, and flexible asbestus.

Geographic Situation.

Europe.—It is found at Idria in the Friaul; Niderslana in Upper Hungary; Morsfeldt and Wolfstein in the Palatinate;

tinate; Moschellandsberg and Stahlberg in Deux-Ponts; Leogang in Salzburg; Horzowitz in Bohemia; Almaden in Andalusia, and Albaracia in Arragon; in slate-clay at Paterno in Sicily; and at Oristani in Sardinia.

America.—Guancavelica in Peru.

Uses.

This metal is used in the construction of barometers and thermometers; also for collecting gases absorbable in water; and its property of amalgamating, enables the metallurgist to extract, at a small expence, minute portions of gold and silver from poor ores *. When amalgamated with tin, it is used for silvering mirrors: amalgams of gold and silver are employed for plating other metals †; and the amalgam of mercury and bismuth is used for the rubbers of electrical machines. In the oxidated and saline states, it acts as a powerful medicine.

Observations.

1. The greater part of the mercury of commerce is obtained by distilling native cinnabar, not from native mercury, which occurs but in small quantity.

2. When rendered solid by artificial freezing mixtures, it is found to be malleable, and to crystallize in octahedrons.

3. The fracture of congealed mercury is hackly.

2. Dodecahedral

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* The amalgamation of gold and silver appears to have been known to the ancients.—Vid. Plin. Hist. Nat. xxxiii.; Vitruvius, viii. 8.

† The process of gilding is mentioned by Pliny.—Vid. Plin. l. c. ed. Bip. p. 101.

2. Dodecahedral Mercury, or Native Amalgam.

Natürliches Amalgam, *Werner.*

Amalgam natif d'Argent, *Romé de Lisle*, t. iii. p. 162.—Natürliches Amalgam, *Wern.* Pabst. b. i. s. 7. *Id. Wid.* s. 722.—Natural Amalgama, *Kirw.* vol. ii. p. 223.—Natürliches Amalgam, *Emm.* b. ii. s. 134.—Amalgame natif d'Argent, *Lam.* t. i. p. 432. *Id. Broch.* t. ii. p. 99.—Mercure argenteal, *Haüy*, t. iii. p. 432.—Amalgam, *Reuss*, b. iii. s. 273. *Id. Lud.* b. i. s. 205. *Id. Suck.* 2ter th. s. 111. *Id. Bert.* s. 433. *Id. Mohs*, b. iii. s. 99. *Id. Leonhard*, Tabel. s. 51.—Mercure argental, *Brong.* t. ii. p. 242. *Id. Brard*, p. 254.—Amalgam, *Karsten*, Tabel. s. 60. *Id. Haus.* s. 69.—Quicksilver alloyed with Silver, *Kid*, vol. ii. p. 94.—Mercure argental, *Haüy*, Tabl. p. 77.—Natürlich Amalgam, *Haus.* Handb. b. i. s. 107. *Id. Hoff.* b. iii. s. 21.—Silver Amalgam, *Aikin*, p. 81.

This species is divided into two subspecies, viz. Fluid or Semi-fluid Amalgam, and Solid Amalgam.

First Subspecies.

Fluid or Semi-fluid Amalgam.

Flüssiges oder halbflüssiges Amalgam, *Werner.*

External Characters.

Its colour is intermediate between tin-white and silver-white, according as it contains more or less silver, but usually inclines more to the first.

It occurs very rarely massive and disseminated, usually in small roundish portions; and crystallized in the following figures:

1. Rhomboidal

1. Rhomboidal dodecahedron.
   a. Rarely perfect, generally
   b. Truncated, more or less deeply, on all the edges.

The crystals are small and very small, and generally singly superimposed.

Externally it is shining and splendent, with a metallic lustre. Internally shining.

The fracture is small grained uneven.

When pressed between the fingers, or cut with a knife, it emits a creaking sound like artificial amalgam.

It is as hard as talc.

Specific gravity 10.5.

Constituent Parts.

Mercury, - -	74
Silver, - - -	25
	99

Heyer, in Crell's Annalen, 1790, b. ii. s. 36. 44.

Geognostic and Geographic Situations.

It is generally associated with native mercury and cinnabar. It is found at Moschellandsberg in Deux-Ponts; and it is said also at Rosenau in Hungary.

Second Subspecies.

Solid Amalgam.

Festes Amalgam, *Werner.*

Festes natürlich Amalgam, *Hoff.* b. iii. s. 24.

External

External Characters.

Its colour is silver-white, which in some varieties falls into tin-white.

It occurs massive and disseminated.

Its lustre is shining, approaching to glistening.

The fracture is flat conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is as hard as gypsum, and sometimes even as hard as calcareous-spar.

It is rather brittle, and rather easily frangible.

It creaks strongly when cut.

Specific gravity 10.5.

Chemical Characters.

Before the blowpipe, the mercury is volatilised, and a bead of pure silver remains. It whitens the surface of copper when rubbed warm on it.

Constituent Parts.

Mercury, - - -	74	64
Silver, - - -	25	36
	99	100
	Heyer.	*Klaproth*, Beit. b. i. s. 183.

Geognostic Situation.

It is usually accompanied with native mercury and cinnabar; it also occurs along with native silver, and iron-pyrites; and the earthy minerals with which it is associated, are calcareous-spar, quartz, heavy-spar, hornstone, &c.

Geographic

Geographic Situation.

It is found at Rosenau and Niderslana in Hungary; Morsfeld in the Palatinate; Moschellandsberg and Stahlberg in Deux-Ponts; in the Leogang in Salzburg; and Sahlberg in Sweden.

Observations.

1. It is distinguished from *Native Silver*, by fracture, tenacity, and frangibility.

2. Native silver, when rubbed on copper, does not whiten it as amalgam does.

3. The name *Quicksilver* was given to this mineral, on account of its fluid form, and silvery aspect.

GENUS V. COPPER.

This genus contains one species, viz. Octahedral Copper.

1. Octahedral Copper.

Octaedrisches Kupfer, *Mohs.*

Gediegen Kupfer, *Werner.*

Cuprum nativum, *Wall.* t. ii. p. 274.—Cuivre natif, *Romé de Lisle*, t. iii. p. 305.—Gediegen Kupfer, *Werner*, Pabst. b. i. s. 62. *Id. Wid.* s. 737.—Cuivre natif, *De Born*, t. ii. p. 303. —Native Copper, *Kirw.* vol. ii. p. 128.—Gediegen Kupfer, *Estner*,

Estner, b. iii. s. 459. *Id. Emm.* b. ii. s. 206.—Le Cuivre natif, *Broch.* t. ii. p. 158. *Id. Haüy*, t. iii. p. 518.–529.—Gediegen Kupfer, *Reuss*, b. iii. s. 392. *Id. Lud.* b. i. s. 219. *Id. Suck.* 2ter th. s. 168. *Id. Bert.* s. 377. *Id. Mohs*, b. iii. s. 200. *Id. Hab.* s. 106.—Cuivre natif, *Lucas*, p. 124.—Gediegen Kupfer, *Leonhard*, Tabel. s. 56.—Cuivre natif, *Brong.* t. ii. p. 211. *Id. Brard*, p. 279.—Gediegen Kupfer, *Karsten*, Tabel. s. 62. *Id. Haus.* s. 69.—Native Copper, *Kid*, vol. ii. p. 98.—Cuivre natif, *Haüy*, Tabl. p. 85.—Gediegen Kupfer, *Haus.* Handb. b. i. s. 111. *Id. Hoff.* b. iii. s. 84.—Native Copper, *Aikin*, p. 84.

External Characters.

Its colour is copper-red, but is frequently tarnished yellowish, and often incrusted with green.

It occurs massive, disseminated, in angular pieces, in grains, membranes, plates, capillary, filiform, botryoidal, irregular dendritic, ramose, with impressions; and crystallized in the following figures:

1. Perfect cube *, fig. 163. Pl. 8.
2. Cube truncated on the angles, which is the middle crystal between the cube and the octahedron †, fig. 164. Pl. 8.
3. Cube truncated on the edges, which is the middle crystal between the cube and the rhomboidal or garnet dodecahedron ‡.
4. Cube truncated on all the edges and angles, fig. 165. Pl. 8.

5. Rhomboidal

* Cuivre natif cubique, Haüy.

† Cuivre natif cubo-octaedre, Haüy.

‡ Cuivre natif cubo-dodecaedre, Haüy.

5. Rhomboidal or garnet dodecahedron, fig. 166. Pl. 8.
6. Perfect octahedron, sometimes truncated on the edges *, fig. 167. Pl. 8.
7. Rectangular four-sided prism, flatly acuminated with four planes, which are set on the lateral planes †.

The crystals are seldom middle-sized and small, usually very small and microscopic. They seldom occur singly imbedded and superimposed, more commonly aggregated in a variety of external shapes.

The lateral planes of the crystals are sometimes smooth, sometimes drusy; the lustre of the surface of the crystals is splendent; that of the other shapes is glistening.

Internally it is intermediate between glistening and glimmering, and the lustre is metallic.

The fracture is hackly.

The fragments are indeterminate angular, and blunt-edged.

The streak is splendent, with metallic lustre.

It is intermediate between semihard and soft; it is harder than silver.

It is completely malleable.

It is flexible, but not elastic.

It is difficultly frangible.

Specific gravity, 8.4, 8.7, *Mohs.*—8.6, *Hausmann.*

Chemical Characters.

When copper is allowed to stand for some time in ammonia, it communicates to it a blue colour: it is fusible before

* Cuivre natif octaedre, Haüy.

† The figures enumerated above, also refer to the principal crystallisations of Native Gold, Native Silver, and Silver-glance.

before the blowpipe into a bead of apparently pure copper.

Constituent Parts.

Native Copper from Ekatharineburg.

Copper, - -	99.80
Trace of Gold and Iron,	
	100.0

John, Chem. Untersuch. b. i. s. 256.

Geognostic Situation.

No metal occurs so frequently in a native state as copper, and it is often met with in large masses on the surface of the earth, particularly in uncultivated and remote regions. In the interior of the earth, it generally occurs in veins, where it is usually associated with red copper and brown iron-ore, seldomer with red iron-ore, copper-glance or vitreous copper-ore, copper-pyrites, malachite, and copper-green, and most rarely with olivinite, and its congenerous species. The rocks in which these veins are contained, are granite, gneiss, mica-slate, chlorite-slate, talc-slate, foliated granular limestone, and grey-wacke. It also occurs imbedded in masses, or in drusy cavities, in serpentine, amygdaloid, flœtz limestone, and flœtz ironstone. The earthy minerals with which it is generally associated in the different formations, are, quartz, calcareous-spar, chlorite, and a kind of soft clay.

Geographic Situation.

Europe.—It occurs in small veins and imbedded portions in serpentine, in the Island of Yell, one of the Shetland Islands;

Islands; in red sandstone, along with copper-pyrites, grey copper, malachite, brown hematite, sparry iron, and iron-pyrites, in Mainland, the largest of the Shetland Islands. It has been long known as a mineral production of Cornwall, where it occurs in veins that traverse granite, and clay-slate, along with tinstone, red copper, malachite, iron-ore, common quartz, rock-crystal, sometimes with chlorite, &c. It generally occurs near the surface, or only a few fathoms under it, although there are instances of its being found very deep in some of the veins. It is met with in the mines named Huel-Unity, Cook's Kitchen, Mullion, Camborne, St Just, Poldory, and also in the rocks of the Lizard. It occurs in Nalsoe, one of the Faroe Islands, imbedded in amygdaloid, along with fibrous and radiated zeolite, and copper-green; in the Bear Islands in the White Sea; at Gullardsrud-schurf in Norway, in serpentine; at Friedrichs-minde, also in Norway, along with earthy blue copper, and copper-green, in grey hornstone and limestone; at Guldholmen, near Moss in Norway, along with calcareous-spar, in a trap rock; at Fahlun in Sweden; in the Hartz, as at Blankenburg, where it is associated with brown-spar, and brown hematite, in veins that traverse grey-wacke-slate; in different venigenous formations that traverse gneiss, in the Saxon Erzgebirge; in beds of bituminous marl-slate at Bottendorf in Thuringia; in the Brennthal, near Mühlbach in Salzburg, in clay-slate; at Kamsdorf in the Westerwald, in beds of ironstone; at Altenkirchen, in veins that traverse grey-wacke, where it is associated with brown iron-ore, malachite, red copper, copper-green, copper-glance or vitreous copper-ore, and quartz; at Reichenbach, near Oberstein, in flœtz amygdaloid, along with prehnite; at St Bel, near Lyons in

France;

France; in veins that traverse gneiss, in the Kenzigerthall in Suabia; in the mine of Maria-Taferl, at Moldowa in the Bannat, in syenite-porphyry; and in different mines in Hungary.

Asia.—In the Island of Japan, along with red copper, and brown iron-ore; in large masses in the Kurile Islands; in the Altain and Uralian Mountains; Kamschatka; and China.

North America.—In masses in the soil in Canada; on the banks of Copper-mine River, on the confines of the Arctic Ocean; in the mines of Ingaran, near the base of the volcano of Jorullo, in Mexico, along with copper-glance or vitreous copper-ore, and red copper; in the intendancy of Valladolid; and in the province of New Mexico.

South America.—Large masses of native copper are met with on the surface of the uncultivated and thinly inhabited regions of Brazil; and Professor Vandilli informs us, that a mass weighing 2600 lb. was found in a valley near to Cachoeira, in that country. It measures 3 feet 2 inches in length, 2 feet 1 inch in breadth, and 10 inches in thickness. Its surface is rough, and covered in some places with malachite and red copper. Very lately, an American gentleman, Dr Baron, discovered a large mass of native copper in the river Onatanagan, to the south of the Lake Superior. He describes it as measuring 12 feet in circumference at one end, and 14 feet at the other. It is also met with in the upper mines of Chili.

Uses.

The copper used for economical and other purposes is obtained from the ores of copper afterwards to be describ-

ed

ed, native copper seldom occurring in any considerable quantity. Combined with zinc, it forms the useful compound called *Brass*, and with tin, *Bell-metal* or *bronze*. It is also used in coinage, either pure, or when combined with gold or silver, to which it gives a greater degree of tenacity. Its oxide is employed in colouring glass and porcelain green; and when combined with acetic acid, it affords the well-known pigment called *Verdigris*. Great quantities of it are used for sheathing the bottom of ships intended for long voyages into warm climates, to preserve them from the attack of the *Teredo navalis*, and other destructive vermes. When covered with tin, it is employed for culinary vessels.

This metal, as already mentioned, is occasionally found in great masses, dispersed over the surface of the earth in uncultivated countries: hence Werner conjectures, that it was the first metal worked by man. From its known metallic characters, this opinion may be considered as very probable, especially when supported by the account which is given of some of the native tribes of the north-western parts of America, who, though little civilized, have applied to domestic purposes the native copper with which their country abounds. It is also known, that, at a very early period, domestic utensils, and instruments of war, were made of a compound of this metal and tin: even during the Trojan war, as we learn from Homer, the combatants had no other armour but what was made of bronze, which is a mixture of copper and tin. Macrobius, who wrote in the fourth century, informs us, that when the Etruscans intended building a new city, they marked out its limits with a coulter of brass, and that priests of the Sabines were in the habit of cutting their hair with a knife of the same

same metal *. The Greek and Roman sculptors executed fine works of art in porphyry, granite, and other hard minerals, by means their copper instruments. The great hardness of the ancient copper instruments, has induced historians to believe, that the ancients possessed a particular secret for tempering copper, and converting it into steel. There is no doubt the axes and other ancient tools were almost as sharp as steel instruments; but it was by a mixture with tin, and not by any tempering, that they acquired their extreme hardness. Axes, and other instruments of copper, have been discovered in the tombs of the ancient Peruvians, and also in those of the early inhabitants of Mexico. These were so hard, that the sculptors of these countries executed large works in the hardest greenstone and basaltic porphyry: their jewellers cut and pierced the emerald, and other precious stones, by using at the same time a metal tool and a siliceous powder. Humboldt brought with him from Lima an ancient Peruvian chisel, in which M. Vauquelin found 0.94 of copper, and 0.06 of tin. This mixture was so well forged, that, by the closeness of the particles, its specific gravity was 8.815; while, according to the experiments of M. Briche, chemists never obtain this maximum of density, but by a mixture of 16 parts of tin, with 100 parts of copper. It appears that the Greeks and Romans made use of both tin and iron at the same time in the hardening of copper. Even a Gaulish axe, found in France by M. Dupont de Nemours, which cuts wood like a steel axe, without breaking or yielding, contains, according to the analysis of Vauquelin, 87 of copper, 3 of iron, and 9 of tin †.

Observations.

* Macrobius, Saturnalia, lib. v. cap. 19. p. 29. 512.

† Humboldt's New Spain.

Observations.

1. Native Copper is distinguished from *Copper-nickel*, by its malleability, and inferior degree of hardness; copper-nickel being semi-hard, bordering on hard, and brittle.

2. When iron-plates are put into a solution of copper vitriol, their surfaces soon become covered with a coating or crust of malleable copper, which is called Copper of Cementation. As copper thus formed is an artificial product, it cannot be included in a system of oryctognosy.

GENUS VI. IRON.

THIS Genus contains one Species, viz. Octahedral Iron.

1. Octahedral Iron.

Octaedrisches Eisen, *Mohs*.

Gediegen Eisen, *Werner*.

This Species is divided into two Subspecies, viz. Terrestrial Native Iron, and Meteoric Native Iron.

First Subspecies.

Terrestrial Native Iron.

Tellureisen, *Werner*.

Gediegen Eisen, *Charpentier*, Mineralogische Geographie von Sachsen, s. 343.—Fossiles gediegen Eisen, *Klaproth*, Beit.

b. iv. s. 102.—Fer natif amorphe, *Haüy*, Tabl. p. 93.—Massive Native Iron, *Aikin*, p. 96.

External Characters.

Its colour is steel-grey.

It occurs massive, in plates, and in leaves.

Internally it is glistening, and the lustre is metallic

The fracture is hackly.

It is opaque.

It is malleable; but not in so high a degree as meteoric iron.

It is hard.

It is magnetic.

Constituent Parts.

From the mine named Johannes, near Great Kamsdorf in Saxony.

Iron,	-	-	92.50
Lead,	-	-	6.00
Copper,	-	-	1.50
			100.00

Klaproth, Beit. b. iv. s. 106

Geognostic and Geographic Situations.

It is said to have been found associated with brown ironstone, sparry ironstone, and heavy-spar, at Kamsdorf*; along with clay and hematite at Eibenstock †; with brown ironstone and quartz, in a vein in the mountain of Oulle, in

* Charpentier, Mineralog. Geographie v. Sachsen, s. 343.

† Werner's Pabst. b. i. s. 130.

in the vicinity of Grenoble *; at Miedziana-Gora in Poland †; in the scoriæ of the volcanic mountain of Graveneire, in the department of Puy de Dome ‡; imbedded in American iron-pyrites ||; and it is said in the island of Bourbon §.

Observations.

1. Lucas mentions a pseudo-volcanic *steel*, found near the village of Bouiche, in the department of the Allier in France. It was discovered by M. Mossier, in the form of small globules imbedded in minerals, which had been scorified by the fire of a coal-mine, formerly in a state of inflammation.

2. The Kamsdorf and Eibenstock irons appear to be accidental artificial masses.

Second Subspecies.

Meteoric Native Iron.

Meteoreisen, *Karsten.*

Plin. Hist. Nat. xxxiv. 14. (41. ed. Bip. v. 260.) & ii. 56. (ed. Bip. s. 166.) ¶.—Meteorstein, *Klaproth,* Beit. b. iv. s. 99. 101.

* Schreiber, in Journal de Physique, Juillet 1792.

† Journal de Physique, t. 65. p. 128.

‡ Mossier, in Lucas's Tableau, t. 2. p. 367.

|| Proust, Journal de Physique, t. 61. p. 272.

§ Brong. t. 2. p. 148.

¶ Differentia ferri numerosa: Prima, in genere terræ cœlive: Item, ferro (pluisse) in Lucanis, anno antequam M. Crassus a Parthis interemptus est,

101. *Id. Leonhard,* Tabel. s. 62. *Id. Karsten,* Tabel. s. 64. —Fer natif meteorique, *Haüy,* Tabl: p. 93.—Meteoreisen, *Haus.* Handbuch. b. i. s. 114.—Fer natif meteorique, *Lucas,* t. ii. p. 358.—Meteoric Native Iron, *Aikin,* p. 95.

External Characters.

Its colour is pale steel-grey, which inclines to silver-white, like platina. It is generally covered with a thin brownish crust of oxide of iron.

It occurs ramose, imperfect globular, and disseminated in meteoric stones.

Its surface is smooth and glistening.

Internally it is intermediate between glimmering and glistening, and the lustre is metallic.

The fracture is hackly.

The fragments are blunt-edged.

It yields a splendent streak.

It is intermediate between soft and semi-hard.

It is malleable.

It is flexible, but not elastic.

It is very difficultly frangible.

Specific gravity 7.575, *Karsten.*

Constituent Parts.

	Agram.	Mexico.
Iron, -	96.5	96.75
Nickel, -	3.5	3.25
	100.0	100.00

Klaproth, Beit. b. iv. s. 101, 102.

According

est, omnesque cum eo Lucani milites, quorum magnus numerus in exercitu erat. *Effigies quæ pluit, spongiarum fere similis fuit.*

According to Mr Howard, the native iron found in Siberia, South America, and Senegal, contains a portion of Nickel. The American contains 0.10; the Siberian 0.17; and the Senegambian 0.5 and 0.6.

Geographic Situation.

This subspecies of iron appears to be formed in the atmosphere by some process hitherto unknown to us. It is precipitated towards the surface of the earth in masses of greater or lesser magnitude, and which generally appear to proceed from fire-balls. The fall of masses of iron from the heavens, has been known from a very early period, and instances of it have even occurred in our own times, as will appear from the following enumeration:

1. About 56 years before the Christian era, a mass of spongy iron fell from the atmosphere in Lucania *.

2. In the year 648, a glowing mass, like a fiery anvil, fell from the air, at Constantinople. This appears to have been a mass of iron.

3. Avicenna speaks of a mass of iron weighing 50 pounds, which fell from the air near Lurgea; and Averrhoes of a mass of iron, estimated to weigh 100 pounds, which fell at Cordova in Spain, and of which swords were made.

4. In the year 1164, during the feast of Pentecost, a shower of iron fell in Misnia †.

5. A great mass of iron fell from the air, in a forest near to

* Plin. Hist. Nat. ii. p. 56.

† Georg. Fabric. Rer. Misnic. lib. i. p. 32.

to Neuhof, between Leipsic and Grimma, between the years 1540 and 1550 *.

6. In the year 1559, five stones or masses of iron fell near Miskoz in Transylvania †.

7. In the years 1560 and 1570, many masses of iron fell in different places in Piedmont.

8. In the year 1603, a mass of metal, probably iron, fell in Bohemia.

9. In the year 1652, a mass of iron, weighing 5 pounds, fell in India, about 100 leagues south-east of Lahore.

10. There is preserved in the town of Ellbogen in Bohemia, a mass of iron weighing 200 pounds, which appears to have fallen from the air in the year 1647; and it is said, about the same time, a ball or mass of iron fell from the air on board a ship in the open sea, and killed two men.

11. On the 12th of January 1683, a stone or mass of iron fell near Castrovillari in Calabria ‡.

12. In the bishopric of Agram in Croatia, on the afternoon of the 26th of May 1751, a fire-ball burst with a loud explosion, and two masses of iron fell from it; the one fragment, which weighed 71 pounds, sunk a considerable depth into the earth; and the other, which was 16 pounds weight, fell on the surface of a meadow, at the distance of 2000 paces from the former. The largest fragment is still preserved in the Imperial Cabinet in Vienna.

13. A mass of iron weighing 66 pounds fell at Chantoney in Vendée on the 5th August 1812 ‖.

Besides these undoubted instances of meteoric iron, others

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* Albini, Meissnische Berg-Chronik, p. 139.

† Nic. Isthuansii, Hist. Hungar. l. xx. fol. 394.

‡ Mercati, Metallotheca Vaticani, cap. xix. p. 248.

‖ This fact was communicated by Mr Heuland.

others less certain are mentioned; and of these the most remarkable are the following:

1. Professor Pallas, many years ago, discovered a mass of native iron, about 1600 pounds weight, lying on the surface of a hill between Krasnojark and Abakunsk. It is considered as a holy relic by the natives, who believe that it fell from heaven. It is enveloped in a slight brownish coloured crust, and the vesicular cavities are filled with a mineral of the nature of olivine. It has all the characters, both external and chemical, of meteoric iron: hence it is generally supposed to have had a similar origin.

2. Goldberry, in his journey through Western Africa, in the years 1805–7, found a mass of native iron in the Great Desart of Sahra. Fragments of it were brought to Europe by Colonel O'Hara, and were analysed by Mr Howard, who found it composed of 96 parts of Iron and 4 of Nickel.

3. Barrow mentions a mass of iron he met with on the banks of the Great Fish River, in Caffraria, in Southern Africa. Chladni is of opinion that it is meteoric; but Barrow considers it as an artificial mass.

4. Several masses of native iron have been met with in Mexico. A mass found at Zacatecas, about fifteen years ago, according to Humboldt, still weighed nearly 2000 pounds.

5. Bougainville, the French circumnavigator, discovered an enormous mass of native iron on the banks of the river La Plata in South America. It is calculated to weigh about 100,000 pounds. It has not been analysed.

6. Many years ago, a mass of native iron, calculated to weigh about 30 tons, was discovered in the district of St Jago del Estro, in South America. It lies in the middle of a great plain, and no rock or mountain within an hundred

dred miles of it. Proust ascertained that it contained nickel: and Howard found it composed of 90 parts of iron and 10 of nickel in 100 parts. This fact, with its general aspect, strongly favours the idea of its meteoric origin.

7. Dr Bruce, in the American Mineralogical Journal, mentions a mass of iron, weighing 3000 pounds, which is said to have been found near the Red River. It is 3 feet 4 inches in length, and 2 feet 2 inches in breadth. Its specificgravity is 7.400. According to Professor Silliman and Colonel Gibbs, it contains nickel as a constituent part.

8. A large mass of iron, supposed to be meteoric, has been ascertained to exist on the shores of Baffin's Bay, by the expedition under Captain Ross *.

Genus VII. ARSENIC.

This Genus contains one Species, viz. Native Arsenic.

1. Native Arsenic.

Gediegen Arsenik, *Werner & Mohs.*

Cadmia bituminosa of *Agricola*.—Arsenicum nativum, *Wall.* t. ii. p. 161.—Gediegen Arsenik, *Wern.* Pabst. b. i. s. 207. *Id. Wid.* s. 965.—Native Arsenic, *Kirw.* vol. ii. p. 255.—Arsenic testacé, *De Born*, t. ii. p. 194.—Gediegen Arsenic, *Emm.* b. ii. s. 548.—Arsenic natif, *Lam.* t. i. p. 353. *Id. Haüy*, t. iv. p. 220. *Id. Broch.* t. ii. p. 435.—Gediegen Arsenik, *Reuss*, b. iv.

* My young friend and pupil Dr Fyffe informs me, he has detected about 3 *per cent.* of Nickel in the Iron of Baffin's Bay,—a circumstance which increases the probability of its being of meteoric origin.

b. iv. s. 494. *Id. Lud.* b. i. s. 297. *Id. Suck.* 2ter th. s. 442. *Id. Bert.* s. 500.—Arsenic natif, *Lucas*, p. 162. *Id. Brard*, p. 359.—Gediegen Arsenik, *Leonhard*, Tabel. s. 78.—Arsenic natif, *Brong.* t. ii. p. 80.—Gediegen Arsenic, *Karsten*, Tabel. s. 74. *Id. Haus.* s. 70.—Arsenic natif, *Haüy*, Tabl. p. 108. —Gediegen Arsenic, *Haus.* b. i. s. 120. *Id. Hoff.* b. iii. s. 207.—Native Arsenic, *Kid*, vol. ii. p. 203. *Id. Aikin*, p. 125.

External Characters.

On the fresh fracture it is whitish lead-grey, inclining to tin-white: it, however, tarnishes very quickly, first grey, and then greyish-black.

It occurs massive, disseminated, in plates, reniform, botryoidal, reticulated, with rhomboidal, cubical, and conical impressions; also in distinct concretions, which are straight and scopiform radiated, small and fine granular, and thin and curved lamellar.

Externally it is either rough or granulated, and very feebly glimmering.

Internally, on the fresh fracture, it is usually glistening, inclining to glimmering, sometimes to shining, and the lustre is metallic.

The fracture is small, and fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is harder than calcareous-spar, but not so hard as fluor.

It is difficultly frangible.

It is rather sectile.

The streak is shining and metallic.

When struck, it has a ringing sound, and emits an arsenical odour.

Specific

Specific gravity, 5.7249, 5.7633, *Brisson.*—5.670, *Kirwan.*—5.7, 5.8, *Mohs.*

Chemical Characters.

Before the blowpipe it yields a white smoke, diffuses an arsenical odour, burns with a blue flame, is gradually and almost entirely volatilised, and deposites a white coating on the coal.

Constituent Parts.

It usually contains a small portion of iron, and when it occurs with gold or silver, a little gold or silver.

Geognostic Situation.

It occurs in veins in primitive rocks, as in gneiss, mica-slate and clay-slate, and less frequently in transition and secondary rocks. In these repositories it is generally found where several veins cross, and then it is a frequent precursor of rich bursts of silver or cobalt, or it points out the termination of valuable accumulations of ores. It is frequently associated with red silver, silver-glance or sulphuretted silver-ore, arsenical pyrites, orpiment, and galena or lead-glance; sometimes also along with native silver, silver-white cobalt, grey copper-ore, grey antimony-ore, copper-nickel, sparry iron, iron-pyrites, copper-pyrites, heavy-spar, calcareous-spar, brown-spar, fluor-spar, and quartz.

Geographic Situation.

Europe.—It occurs at Kongsberg in Norway, along with ores of silver, cobalt, and antimony, at Andreasberg in the Hartz, and Allemont in France: in veins along with red silver,

silver, in mica-slate, at Joachimsthal in Bohemia, and with the same mineral in gneiss, at Freyberg in Saxony, and at Ste Marie aux Mines in France; and it is also found in Silesia, Suabia, Spain and Hungary.

Asia.—In large masses at the bottom of a silver-mine at Zimeof in Siberia.

America.—St Felix in Chili *.

Genus VIII.—BISMUTH.

This Genus contains one Species, viz. Octahedral Bismuth.

1. Octahedral Bismuth.

Octaedrisches Wismuth, *Mohs.*

Gediegen Wismuth, *Werner.*

Wismuthum nativum, *Wall.* t. ii. p. 205.—Gediegen Wismuth, *Werner*, Pabst. b. i. s. 183. *Id. Wid.* s. 887.—Native Bismuth, *Kirw.* vol. ii. p. 264.—Bismuth natif, *De Born*, t. ii. p. 214.—Gediegen Wismuth, *Emm.* b. ii. s. 434.—Bismuth natif, *Lam.* t. ii. p. 331. *Id. Haüy*, t. iv. p. 184. *Id. Broch.* t. ii. p. 343.—Gediegen Bismuth, *Reuss*, b. iv. s. 310. *Id. Mohs*, b. iii. s. 633.—Bismuth natif, *Brong.* t. ii. p. 131. *Id Haüy*, Tabl. p. 105.—Gediegen Wismuth, *Haus.* Handb. b. i. s. 123. *Id. Hoff.* b. iv. s. 65.—Native Bismuth, *Aikin*, p. 121.

External

* Heuland.

External Characters.

Its colour on the fresh fracture surface is silver-white, which inclines to red; but by exposure it soon becomes tarnished, with columbine or temper steel colours.

It is seldom massive, generally disseminated, and in leaves having plumosely streaked surfaces; also dentiform, in coarse, small and fine granular distinct concretions, and crystallized in the following figures:

1. Octahedron.
2. Tetrahedron, in which the angles are truncated.
3. Cube.

The crystals are small and very small.

Internally it is splendent, and the lustre is metallic.

It has a fourfold cleavage, the folia in the direction of the planes of the octahedron.

The fragments are indeterminate angular and blunt-edged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is malleable.

It is rather difficultly frangible.

Specific gravity, 8.9, 9.0, *Mohs.*—9.570, *Kirwan.*—9.0202, *Brisson.*

Chemical Characters.

It melts even by the flame of a candle; before the blowpipe, it melts very quickly to a silver-white globule, which, by continuance of the heat, is volatilized, and deposites a white covering on the charcoal. It dissolves with effervescence in nitric acid; but if we add water to the solution, it is precipitated into the form of a white powder.

Geognostic

Geognostic Situation.

It occurs in veins in gneiss, mica-slate, and clay-slate. It is usually accompanied with ores of cobalt, particularly tin white cobalt and grey cobalt; also with copper nickel, bismuth ochre, iron pyrites, sparry iron, and brown blende; sometimes with native silver, and very seldom with galena or lead-glance; the vein-stones are quartz, hornstone, calcareous-spar, brown spar, and heavy spar.

Geographic Situation.

Europe.—It is found at St Columb and Botallack, in Cornwall, but more frequently at Johanngeorgenstadt and Schneeberg, in the Kingdom of Saxony, than in any district in Europe: it occurs also in considerable quantity at Joachimsthal in Bohemia; and in less abundance in the Black Forest (Schwarzwald) in Swabia. It has been also met with at Zalathna in Transylvania; Temeswar in the Bannat; at Biber in Hanau; St Sayeur, and in the mines of Brittany in France; Dalecarlia and Nerike in Sweden; and Modum in Norway.

America.—It occurs at Huntington, parish of New-Stratford, in the State of Connecticut, in a vein of quartz, along with native silver, common and magnetic pyrites, and galena or lead-glance

Uses.

It enters as an ingredient into the composition of printing types, and of pewter; is used as solder, in the construction of mirrors, and for the refining of gold and silver; its oxide

* Bruce's American Mineralogical Journal, p. 267.

is used as a white pigment, as an essential ingredient in a kind of salve, which is used for giving a black colour to the hair, and as an ingredient in sympathetic ink. All the bismuth of commerce is obtained from Saxony.

Observations.

1. Its principal characters are, colour, cleavage, malleability, softness and weight.

2. It is distinguished from *Bismuth-glance* by its colour and regular external figures; the recticulated varieties, from *Reticulated Native Silver*, by their colour and inferior malleability; and its colour and hardness distinguish it from *Native Antimony*.

Genus IX. ANTIMONY.

This Genus contains two Species, viz. Dodecahedral Antimony, and Octahedral Antimony.

1. Dodecahedral Antimony.

Spiesglas, *Mohs*.

Gediegen Spiesglas, *Werner*.

Swab, in d. Schriften der K. Schwed. Acad. 10. b. v. I. 1748. s. 100.—Regulus Antimonii nativus, *Wall.* t. ii. p. 196.—Gediegen Spiesglas, *Werner*, Pabst. b. i. s. 197. *Id. Wid.* s. 909. —Native Antimony, *Kirw.* vol. ii. p. 245.—Antimonie natif, *De*

De Born, t. ii. p. 137.—Gediegen Spiesglas, *Emm.* b. ii. s. 464.—Antimonie natif, *Haüy*, t. iv. p. 252.—L'Antimonie natif, *Broch.* t. ii. p. 369.—Gediegen Spiesglanz, *Reuss*, b. iv. s. 362. *Id. Lud.* b. i. s. 277. *Id. Suck.* 2ter th. s. 383. *Id. Bert.* s. 475. *Id. Mohs*, b. iii. s. 688.—Antimonie natif, *Lucas*, p. 171.—Gediegen Spiesglanz, *Leonhard*, Tabel. s. 78.—Antimoine natif, *Brong.* t. ii. p. 126. *Id. Brard*, p. 370.—Gediegen Spiesglanz, *Karsten*, Tabel. s. 72. *Id. Haus.* s. 70.—Native Antimony, *Kid*, vol. ii. p. 199.—Antimoine natif, *Haüy*, Tabl. p. 112.—Gediegen Spiesglanz, *Hoff.* b. iv. s. 99. *Id. Haus.* Handb. b. i. s. 125.—Native Antimony, *Aikin*, p. 123.

External Characters.

Its colour is perfect tin-white. On the fresh fracture it sometimes becomes covered with a yellowish or greyish tarnish.

It occurs massive, disseminated, reniform; also in distinct concretions, which are coarse, small, and fine angulo-granular, and the latter are collected into thin and curved lamellar; and crystallized, in the following figures:

1. Octahedron.
2. Rhomboidal dodecahedron.

On the fresh fracture it is splendent, and the lustre is metallic.

Its cleavage is octahedral and dodecahedral.

The fragments are sometimes octahedral or dodecahedral, more usually indeterminate angular, and blunt-edged.

It is harder than calcareous-spar, but not so hard as fluor-spar.

It is rather sectile, and easily frangible.

Specific gravity, 6.720, *Klaproth*, 6.5, 6.8, *Mohs*.

Chemical

Chemical Characters.

Before the blowpipe it melts easily, and volatilizes in the form of a grey inodorous vapour; if the melted globule be allowed to cool slowly, it becomes covered with white brilliant acicular crystals. A very minute globule of silver generally remains after the antimony has been dissipated.

Constituent Parts.

	Andreasberg.
Antimony, - -	98.00
Silver, - -	1.00
Iron, - -	0.25
	99.25*

Klaproth, Beit. b. iii. s. 172.

Geognostic and Geographic Situations.

Europe.—It is found in argentiferous veins in the gneiss mountain of Chalanches in Dauphiny, where it is accompanied with grey antimony or antimony-glance, white antimony, red antimony, silver-white cobalt, and quartz; at Andreasberg in the Hartz, associated with red silver, calcareous-spar and quartz; at Sahlberg, in Westermannland in Sweden, disseminated in calcareous spar.

America.—At Cuencamé in Mexico.

Observations.

* It is sometimes alloyed with a small and variable proportion of arsenic; in consequence of which, its vapour, when exposed to the blowpipe, has an arsenical odour.

Observations.

1. It is characterized by colour, cleavage, distinct concretions, hardness and weight.

2. It is distinguished from *Native Bismuth* by colour, want of tarnish, and inferior specific gravity; from *Antimonial Silver* by inferior specific gravity, and in some degree by colour.

2. Octahedral Antimony.

Octaedrisches Spiesglas, *Mohs.*

This Species contains two Subspecies, viz. 1. Antimonial Silver, 2. Arsenical Silver.

First Subspecies.

Antimonial Silver.

Spiesglas Silber, *Werner.*

Mine d'Argent blanche antimoniale, *Romé de Lisle*, t. i. p. 460. —Antimonialisch gediegen Silber, *Wid.* s. 684.—Antimoniated Native Silver, *Kirw.* vol. ii. p. 110.—Spies-glanz Silber, *Estner*, b. iii. s. 337. *Id. Emm.* b. ii. s. 162.—Argent antimonial, *Broch.* t. ii. p. 119. *Id. Haüy*, t. iii. p. 391.—Spiesglanz Silber, *Reuss*, b. iii. s. 325. *Id. Lud.* b. i. s. 211. *Id. Suck.* 2ter th. s. 135. *Id. Bert.* s. 369. *Id. Mohs*, b. iii. s. 127. —Argent antimonial, *Lucas*, p. 104.—Spiesglanz Silber, *Leonhard*, Tabel. s. 53.—Argent antimonial, *Brong.* t. ii. p. 249. *Id. Brard*, p. 243.—Spiesglanz Silber, *Karsten*, Tabel. s. 60. *Id: Haus.* s. 70.—Silver alloyed with Antimony, *Kid*, vol. ii. p. 85.—Argent antimonial, *Haüy*, Tabl. p. 74.—Silberspies-

glanz, *Haus.* Handb. b. i. s. 126.—Spiesglas Silber, *Hoff.* b. iii. s. 46.—Antimonial Silver, *Aikin,* p. 76.

External Characters.

Its colour is intermediate between silver-white and tin-white; sometimes inclining more to the one, sometimes more to the other, yet in general more to the first.

It occurs massive, and disseminated; also in distinct concretions, which are coarse, small and fine granular. It is sometimes crystallized, and in the following figures:

1. Rectangular four-sided prism, sometimes truncated, or bevelled on the lateral or terminal edges and angles.
2. Unequiangular six-sided prism.
3. Double six-sided pyramid, truncated on the apices.
   The crystals are sometimes acicular and superimposed.

The surface of the prisms is usually longitudinally streaked; and the massive varieties uneven.

Externally it is glistening, sometimes only glimmering.

Internally it is shining and splendent, with a metallic lustre.

The cleavage is octahedral.

Its hardness is intermediate between that of calcareous-spar and fluor-spar.

It is sectile, and rather easily frangible.

Specific gravity, 9.4, *Haüy.*—10.000, *Selb.*—9.820, *Klaproth.*

Chemical Characters.

Heated on charcoal before the blowpipe, the antimony is volatilized, with the odour which is peculiar to it, and there

there remains a mass of silver, surrounded with a brown slag, which colours borax green.

Constituent Parts.

				Fine Granular from Wolfach.	Coarse Granular from Wolfach.	From Andreasberg.
Silver,	89	78	75.25	84	76	75¼
Antimony,	11	22	24.75	16	24	24¾
	100	100	100.00	100	100	100
	Selb.	*Vauquelin.*	*Abich.*	*Klap.* Beit. b. ii. s. 301.	Ibid.	Ibid. b. iii. s. 176.

Geognostic Situation.

It occurs in veins, in granite and grey-wacke, and in both situations it is associated with arsenical silver, native arsenic, galena or lead-glance, brown blende, and calcareous-spar; but in the granite, it is also accompanied with native silver, red silver, iron pyrites, straight lamellar heavy-spar, and fluor-spar; and in the grey-wacke, with native antimony, red silver, silver-glance, and brown-spar.

Geographic Situation.

It occurs in veins that traverse granite, at Altwolfach in Suabia; in veins that traverse clay-slate, at Andreasberg in the Hartz; at Kasalla, near Guadalcanal in Spain; and, it is said, also at the Rathausberg in Gastein, and the Goldberg at Rauris in Salzburg; and at Allemont in France.

Observations.

It is distinguished from *Native Silver*, by its sectility and cleavage: from *White Cobalt*, by its sectility, and

 inferior

inferior hardness: from *Arsenical Pyrites*, by its cleavage, and inferior hardness.

Second Subspecies.

Arsenical Silver.

Arseniksilber, *Werner*.

Id. Wern. Pabst. b. i. s. 28.—Argent arsenical, *De Born*, t. ii. p. 417.—Arsenikalisch gediegen Silber, *Wid.* s. 687.—Arsenicated native Silver, *Kirw.* vol. ii. p. 111.—Arsenicsilber, *Estner*, b. iii. s. 342. *Id. Emm.* b. ii. s. 165.—L'Argent arsecal, *Broch.* t. ii. p. 122.—Argent antimonial, arsenifere, et ferrifere, *Haüy*, t. iii. p. 398.—Arsenik-silber, *Reuss*, b. iii. s. 499. *Id. Lud.* b. ii. s. 211. *Id. Suck.* 2ter th. s. 144. *Id. Bert.* s. 503. *Id. Mohs*, b. iii. s. 131. *Id. Leonhard*, Tabel. s. 53.—Argent arsenical, *Brong.* t. ii. p. 250.—Silber-arsenik, *Karsten*, Tabel. s. 74.—Silver alloyed with Arsenic and Iron, *Kid*, vol. ii. p. 86.—Argent antimonial ferro-arsenifere, *Haüy*, Tabl. p. 74.—Arsenik-silber, *Hoff.* b. iii. s. 48.—Arsenical Antimonial Silver, *Aikin*, p. 19.

External Characters.

Its colour on the fresh surface is tin-white, which tarnishes greyish black.

It occurs massive, and small reniform; also in distinct concretions, which are reniform curved lamellar.

Internally it is glistening and metallic.

The fracture is small-grained uneven, with a tendency to a cleavage.

The fragments are indeterminate angular and blunt-edged.

It is harder than antimonial silver.

It

It is shining in the streak.

It is sectile, slightly inclining to brittle, and easily frangible.

Specific gravity 9.440, *Haüy*.

Chemical Characters.

Before the blowpipe, the arsenic and antimony are volatilized, and emit a garlic smell; a globule of silver remains, which is more or less pure.

Constituent Parts.

	Andreasberg.
Arsenic, - -	35.00
Iron, - - -	44.25
Silver, - -	12.75
Antimony, - -	4.00
	96.00

Klaproth, Beit. b. i. s. 187

Geognostic and Geographic Situations.

It generally occurs along with native arsenic, dark-red silver, brittle silver-glance, galena or lead-glance, and brown blende, in massive white calcareous-spar. It is found in the Hartz; also at Altwolfach in Suabia; and at Guadalcanal and Kasalla in Spain.

Observations.

It does not tarnish so quickly, and its colour is lighter than that of native arsenic, with which it has been confounded.

GEN. X.

Genus X. TELLURIUM.

This Genus contains one Species, viz. Hexahedral Tellurium.

1. Hexahedral Tellurium.

Hexaedrisches Tellur, *Mohs.*

Gediegen Sylvan, *Werner.*

Tellure natif aurifere et ferrifere, *Haüy*, t. ii. p. 325.—Le Silvane natif, *Broch.* t. ii. p. 480.—Gediegen Tellur, *Reuss*, b. iv. s. 604. *Id. Lud.* b. i. s. 310. *Id. Suck.* 2ter th. s. 492.—Gediegen Sylvan, *Bert.* s. 520. *Id. Mohs*, b. iii. s. 57.—Tellure natif, *Lucas*, p. 185.—Gediegen Tellur, *Leonhard*, Tabel. s. 80.—Tellure natif, *Brong.* t. ii. p. 125. *Id. Brard*, p. 391. —Gediegen Tellur, *Karsten*, Tabel. s. 70. *Id. Haus.* s. 70. —Tellure natif auro-ferrifere, *Haüy*, Tabl. p. 119.—Gediegen Tellur, *Haus.* Handb. b. i. s. 129.—Gediegen Sylvan, *Hoff.* b. iv. s. 126.—Native Tellurium, *Aikin*, p. 139.

External Characters.

Its colour is tin-white.

It occurs massive, disseminated, in small and fine granular distinct concretions, and crystallized in rectangular four-sided prisms acuminated with four planes, which are set on the lateral planes *.

Internally

* Haüy is of opinion, that the primitive form is the regular octahedron.

Internally it is shining, and the lustre is metallic.

Its cleavage is hexahedral.

It is as hard as gypsum, and sometimes harder, but never so hard as calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity, 6.1, 6.2, *Mohs.*—6.115, *Klaproth.*

Chemical Characters.

Before the blowpipe it melts as easily as lead, emits a thick white smoke, and burns with a light green colour, and a pungent acrid odour, like that of horse raddish. When exposed to a low heat, it is converted into a yellowish or blackish coloured oxide: by an increase of temperature it melts into a dark-brown or blackish coloured glass, in which gold grains are interspersed: at a still higher heat, the oxide is entirely volatilized. In concentrated nitric acid, it is converted into a yellow oxide, and a small portion is dissolved, which is precipitated in yellow flakes on the addition of water.

Constituent Parts.

Tellurium, - -	92.55
Iron, - -	7.20
Gold, - -	0.25
	100.00

Klaproth, Beit. b. iii. s. 8.

Geognostic Situation.

It occurs in veins in grey-wacke, along with iron pyrites, sometimes with lead-glance, and always with quartz.

Geographic

Geographic Situation.

It occurs at Facebay in Transylvania; also in Norway, where it has been lately detected by Professor Esmark *.

Observations.

1. It resembles Native Antimony, but is distinguished from it by its inferior hardness, and its lower specific gravity.

2. It is known in older works in mineralogy under the names Aurum paradoxicum, Aurum problematicum, and White Gold-ore.

ORDER II.

* There is a fine specimen of the very rare Norwegian Tellurium in the interesting and instructive cabinet of the Geological Society of London, and another in the splendid collection of Mr Heuland.

ORDER II.—ORE.

GENUS I.—TITANIUM ORE.

THIS Genus contains three Species, viz. 1. Prismatic Titanium Ore, 2. Prismato-Pyramidal Titanium Ore, 3. Pyramidal Titanium Ore.

1 Prismatic Titanium Ore, or Sphene *.

Prismatisches Titan-erz, *Mohs*.

THIS Species is divided into two Subspecies, viz. Common Sphene and Foliated Sphene.

First Subspecies.

Common Sphene.

Gemeiner Sphen, *Karsten*.

Braun Mänakerz, *Werner*.

Titane-Siliceo-Calcaire, *Haüy*.

Brauner Titanit, *Schumacher's* Verz. s. 114.—Titane siliceo-calcaire, *Haüy*, t. iv. p. 307.; also Sphene, *Haüy*, t. iii. p. 114. —Gemeiner Titanit, *Reuss*, b. iv. s. 584. *Id. Suck.* 2ter th. s. 481.

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* The name *Sphene*, is derived from the Greek word σφηνυς, (*a wedge*), because some of the crystals have a wedge-like shape.

s. 481.—Brunon, *Mohs,* b. iii. s. 465.—Titanit, *Leonhard,* Tabel. s. 82.—Gemeiner Sphen, *Karsten,* Tabel. s. 74.—Titane-siliceo-calcaire, *Haüy,* Tabl. p. 116.—Gemeiner Sphen, *Haus.* Handb. b. ii. s. 613. *Id. Hoff.* b. iv. s. 260.—Sphene, *Aikin,* p. 137.

External Characters.

Its colours are reddish, yellowish, and blackish-brown, also grass-green, pistachio-green, asparagus-green, olive-green, yellowish-grey, and greenish-white.

It occurs in granular distinct concretions, and crystallized in the following figures:

1. Low very oblique four-sided prism, acutely bevelled on the extremities, the bevelling planes set on the obtuse lateral edges*. The obtuse lateral edge of the prism is 136° 50′, and the angle of the bevelment is 60°. This is the primitive form †. Fig. 168. Pl. 8.
2. Sometimes the acute angles of the prism are truncated, and the truncating planes set on the acute lateral edges.
3. Broad six-sided prism, with two opposite broader, and four opposite smaller lateral planes, and acuminated with four planes.
4. Rectangular four-sided prism, which is either bevelled on the extremities, or acuminated with four planes, which are set on the lateral planes. This prism is formed when all the edges of the oblique prism are truncated, and the truncating planes

* Titan siliceo-calcaire ditetraedre, Haüy.

† Titan siliceo-calcaire uniternaire, Haüy.

planes meet together, entirely obliterating the oblique planes.

5. Oblique double four-sided pyramid, in which the apices are bevelled.
6. The preceding figure so very flat or obtuse, that it has a lenticular form.

Sometimes two crystals unite, forming either a furrowed or canaliculated twin-crystal *, or a compressed rectangular cruciform one.

The crystals are large, middle-sized, small, and very small.

The surface of the crystals is generally smooth; rarely longitudinally streaked, as in the octahedron.

Internally it is shining or glistening, and the lustre is adamantine, sometimes inclining to resinous, sometimes to vitreous.

The cleavage is imperfect.

The fracture is imperfect conchoidal, which inclines to uneven.

It alternates from opaque, to translucent.

Its streak is greyish or yellowish white.

It is harder than apatite, but not so hard as felspar.

It is brittle, and easily frangible.

Specific gravity, 3.480, *Schumacher*.—3.510, *Klaproth*.—3.4, 3.6, *Mohs*.

Chemical Characters.

Before the blowpipe it is fusible with difficulty into a blackish-brown enamel; with borax it yields a grey-slag; with phosphat of soda a green globule.

Constituent

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* The above figure is the Rayonnanté en forme de gouttiere of Saussure; Sphene canaliculé of Haüy.

Constituent Parts.

	Passau.	Salzburg.	St Gothard.
Oxide of Titanium,	33	46	33.3
Silica, -	35	36	28.0
Lime, - -	33	16	32.2
Water, -	0	1	0
	101	99	93.5
	Klaproth, Beit. b. i. s. 251.	*Ibid.* b. v. s. 344.	*Cordier* in Jour. de Mines, N. 73. 70.

Geognostic and Geographic Situations.

Europe.—It occurs in small and very small crystals, imbedded in the syenite of the Criffle and other hills in Galloway; in the syenite of Inverary; in syenite on the south side of Loch-Ness; in the same rock, in the mountains around the King's House, and in the syenite mountains that extend from that dreary and desolate track towards Inverouran; in the syenite of Ben-Nevis *; the granite of Aberdeen †; in the syenite of Culloden in Inverness-shire ‡; in that between Freeburn and Aviemore; in the syenite of Shetland; and in the flœtz-trap rocks in Mid-Lothian. It is is also found in the iron-mines of Arendal in Norway; Bovkhult in West Gothland, in primitive limestone; in the granite rocks of Trolhätta in Sweden; in the syenite of Passau on the Inn; and in that of Moravia; in the granite or syenite of Nantes in France; in clinkstone in the Sanadoire in the Department of Puy de Dôme; and in the volcanic rocks on the borders of the Rhine: and on St Gothard

* Greenough. † Mr Mackenzie *junior* of Applecross.

‡ MacCulloch.

Gothard and at Salzburg it is associated with chlorite; which mineral is either disseminated through the crystals, or incrusts them.

America.—It is found imbedded in a compound of hornblende, felspar, and graphite, in the vicinity of Lake St George, and in granular foliated limestone at Kingsbridge, island of New-York *.

Africa.—In the antique syenite of Egypt.

Observations.

1. The distinctive characters of this mineral are colour, crystallization, hardness, and weight.

2. The brown varieties are distinguished from *Grenatite*, by inferior hardness, and different form; from *Zircon*, by form, inferior hardness, and inferior specific gravity; the green and yellow varieties from *Epidote*, by cleavage; from *Actynolite*, by greater hardness, weight and crystallizations; and from *Axinite*, by its crystallizations, colours, inferior hardness, and greater weight.

3. Both the brown and yellow subspecies have been described under the name *Titanium Spar*.

Second

* Bruce's American Mineralogical Journal, p. 239,—241.

Second Subspecies.

Foliated Sphene.

Schaaliger Sphen, *Karsten.*

Gelb Mänakerz, *Werner.*

Titane siliceo-calcaire, *Haüy.*

Gelber Titanite, *Schumacher,* Verz. s. 46.—Titane siliceo-calcaire, *Haüy,* t. iv. p. 307.; also Sphene, *Id.* t. iii. p. 114.—Spathiger Titanit, *Reuss,* b. iv. s. 590. *Id. Suck.* 2ter th. s. 485. *Id. Bert.* s. 280.—Titanit, *Leonhard,* Tabel. s. 82.—Schaaliger Sphen, *Karsten,* Tabel. s. 74.—Titan siliceo-calcaire, *Haüy,* Tabl. p. 116.—Spathiger Sphen, *Haus.* Handb. b. ii. s. 614.—Gelb Manakerz, *Hoff.* b. iv. s. 263.—Sphene, *Aikin,* p. 137.

External Characters.

Its colours are pea-yellow, straw-yellow, cream-yellow, honey-yellow, and sulphur-yellow; the pea-yellow passes into clove-brown, and into yellowish-grey.

It occurs massive, in straight lamellar concretions, and crystallized in the same figures as the preceding subspecies.

The crystals vary from large to very small.

The lustre on the cleavage is splendent or shining, on the imperfect conchoidal and uneven fractures, only shining or glistening, and is resinous.

It has a double cleavage, in which the folia are parallel with the lateral planes of the oblique four-sided prism.

The fracture is imperfect conchoidal, inclining to uneven.

It is translucent, or only translucent on the edges.

In

In other characters it agrees with the preceding subspecies.

Its chemical characters and composition are the same as those of common sphene.

Geognostic and Geographic Situations.

Europe.—It occurs at La Portia in Piedmont; St Gothard; at Arendal in Norway, in beds of magnetic ironstone, subordinate to gneiss. In these beds, it is associated with common sphene, epidote or pistacite, hornblende, augite, scapolite, felspar, quartz, calcareous-spar, and garnet. Very small honey-yellow crystals occur in the clinkstone of the Mariaberg, near Aussig in Bohemia.

America.—In primitive limestone at Newton in New Jersey; in an aggregate of felspar, hornblende, and graphite, near Ticonderago, where it was discovered by Colonel Gibbs; in Staten Island, in greenstone and hornblende rocks; in the vicinity of Peeks-hill, New-York, in syenite; and in veins of greenstone or syenite that traverse granite at Wantage, Sussex county, New Jersey *.

Observations.

1. Its distinct cleavage distinguishes it from *Common Sphene;* its crystallizations, and greater hardness, distinguish it from *Sparry Iron;* and its inferior weight and greater hardness, distinguish it from *Tungsten.*

2. The *Semeline* of Andernach, and the *Spinthere* of Marone in Dauphiny, are probably varieties of this mineral.

2. Prismato-

* Bruce's American Mineralogical Journal, p. 239,—242.

2. Prismato-Pyramidal Titanium-Ore.

Prismato-Pyramidales Titan-erz, *Mohs.*

THIS Species is divided into three Subspecies, viz. Rutile, Iserine, and Menachanite.

First Subspecies.

Rutile *.

Rutil, *Werner.*

Titane Oxidé, *Haüy.*

Rother Schorl, *Klap.* b. i. s. 233.—Schorl crystallizé opaque rouge, *De Born,* t. i. p. 168.—Titanite, *Kirw.* vol. ii. p. 329.—Sagenite, ou Schorl rouge, *Saussure,* t. iv. § 1894.—Oxide rouge de Titanium, *Lam.* t. i. p. 414.—Crispite, *Id.* t. ii. p. 233.—Titane oxidé, *Haüy,* t. iv. p. 296.—Le Ruthile, *Broch.* t. ii. p. 470.—Titanschorl, *Reuss,* b. iv. s. 569. *Id. Lud.* b. i. s. 305. *Id. Suck.* 2ter th. s. 476. *Id. Bert.* s. 514. *Id. Mohs,* b. i. s. 455.—Titane oxydé, *Lucas,* p. 180.—Rutile, *Leonhard,* Tabel. s. 82.—Titane ruthile,' *Brong.* t. ii. p. 97.—Titane oxidé, *Brard,* p. 383.—Rutill, *Karsten,* Tabel. s. 74. *Id. Haus.* s. 111.—Native Oxide of Titanium, *Kid,* vol. ii. p. 222.—Titane oxidé, *Haüy,* Tabl. p. 115.—Rutil, *Haus.* Handb. b. i. s. 319. *Id. Hoff.* b. iv. s. 252.—Titanite, *Aikin,* p. 135.

External Characters.

Its most frequent colour is reddish-brown, of various degrees

* *Rutile,* from the Latin *rutilus,* reddish.

grees of intensity, which passes into light hyacinth-red and blood-red. Sometimes dark isabella-yellow.

It occurs massive, disseminated, in membranes; also in lamellar and granular distinct concretions, and crystallized.

Its primitive figure is a pyramid of 117° 2′, and 84° 48′. The following are some of the secondary forms.

1. Long rectangular four-sided prism.
2. The preceding figure truncated on the lateral edges, and thus forming an eight-sided prism.
3. Four-sided prism, in which the lateral edges are bevelled.
4. Four-sided prism acuminated with four planes, which are set on the lateral planes. The edges and apex of the acuminations are sometimes truncated.
5. Six-sided prism, sometimes acuminated with six planes, which are set on the lateral planes, and these are rarely convex *. Fig. 169. Pl. 8.
6. Sometimes two prisms are joined by their terminal planes, under a very obtuse angle, thus forming a kind of twin-crystal †. Fig. 170. Pl. 8.
7. It occurs sometimes in capillary and acicular crystals.

The crystals are occasionally curved; have frequent transverse rents, and are sometimes apparently broken entirely across, the ends removed to some distance from one another, and the interstice filled up with the substance of which the matrix consists.

* Vid. Bruce's American Mineralogical Journal, p. 238, where the above figure is described.

† Titane oxidé géniculé, Haüy.

The crystals are usually small and very small, seldom middle-sized; the capillary crystals are frequently scopiformly aggregated; often reticulated, and the interstices have the shape of equilateral triangles *.

The lateral planes of the crystals are longitudinally streaked, the other planes are smooth.

Externally it is shining and glistening.

Internally the lustre is intermediate beetween adamantine and semi-metallic, and is splendent on the surface of the cleavage, but only shining or glistening in the conchoidal or uneven fractures.

It has a cleavage in which two of the folia are parallel with the lateral planes of the rectangular four-sided prism, and two others parallel with the diagonals of the same prism. Of these cleavages those parallel with the lateral planes are the most distinct.

The fracture is intermediate between coarse-grained uneven, and small and imperfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

Its streak is brown.

It is transparent or only translucent on the edges.

It is harder than apatite.

It is brittle, and easily frangible.

Specific gravity, 4.180, *Klaproth.*—4.247, *La Metherie.*—4.1025, *Haüy.*—4.255, *Lowry.*

Chemical Characters.

Without addition, or even with phosphoric salts, it is infusible before the blowpipe; with borax or alkali, it affords a hyacinth-red transparent glass.

Constituent

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* The reticulated variety was named by Saussure Sagenite, and Schorl tricoté.

Constituent Parts.

According to the analysis of Klaproth, it is pure oxide of titanium, slightly intermixed with oxide of iron. Ekeberge and Vauquelin found in a variety from Westmannland a small portion of oxide of chrome *.

Geognostic Situation.

It is found imbedded, in veins and in drusy cavities, in granite, syenite, gneiss, mica-slate, limestone, chlorite-slate and hornblende-slate.

Geographic Situation.

Europe.—It occurs in the granite of Cairngorm, the limestone of Rannoch, and in the rocks of Ben Gloe, where it was discovered by MacCulloch; also at Craig Cailleach, near Killin in Perthshire, imbedded in quartz, and near to Beddgelert in Caernarvonshire. In Norway it occurs at Arendal, in a vein of granite which traverses gneiss, and in a rock of the same kind at Aschaffenburg. On St Gothard it is met with in those drusy cavities that so often occur in granite, resting on the rock-crystal, adularia, and foliated chlorite, with which they are lined. In the country of Salzburg, it is imbedded in tremolite, and in Hungary in common quartz, and in rock-crystal, which lies in nests in mica-slate. It is found near St Grieux, and at Allemont in France; at Buitrago in Spain, in veins in gneiss along with schorl; at Boinik in Hungary, and in Transylvania.

 Asia.

* Annales du Mus. t. vi. p. 98. It is the Titane oxidé chromifère of Haüy.

Asia.—It is found at the town of Sarapulka, twelve wersts from Mursinska in Siberia.

America.—It occurs in veins of an aggregated rock of felspar, quartz, mica, and granular foliated limestone, which traverse primitive limestone in the island of New-York: also in primitive limestone on the Hudson River; in large quantity imbedded in quartz, in the vicinity of Richmond in Virginia; in quartz in hornblende-slate, at Worthington in Massachusets; in quartz from the neighbourhood of Baltimore; and in quartz near the Schuyler copper-mines in Bergen county, New Jersey. It is also met with in South Carolina; in quartz in the county of Delaware in Pennsylvania, and in the back part of North Carolina, where it is said to occur in great abundance *.

Observations.

1. It is nearly allied to *Tinstone*, but is distinguished from it by colour and inferior specific gravity; and its colours, form, considerable specific gravity distinguish it from *Octahedrite* and *Schorl*.

2. It has been described under the following names:—*Red Schorl*, *Shorlaceous Garnet*, *Titanitic Schorl*. The acicular varieties have been named *Sagenite*, and others *Gallitzinite*.

Second

* Bruce's American Mineralogical Journal, p. 235,—238.

Second Subspecies.

Iserine.

Iserin, *Werner.*

L'Iserine, *Broch.* t. ii. p. 478.—Iserin, *Reuss,* b. iv. s. 598. *Id. Lud.* b. i. s. 306.—Iser-Titan, *Suck.* 2ter th. s. 489.—Iserin, *Mohs,* b. iii. s. 450. *Id. Leonhard,* Tabel. s. 81. *Id. Karsten,* Tabel. s. 74.—Titane oxydé ferrifere, *Haüy,* Tabl. p. 116. —Titaneisenstein, *Haus.* b. i. s. 251.—Iserin, *Hoff.* b. iv. s. 258.—Iserine, *Aikin,* p. 136.

External Characters.

Its colour is iron-black, inclining to brownish-black.

It occurs in small, seldom middle-sized, obtuse angular, grains, and in rolled pieces, with a somewhat rough, strongly glimmering surface.

Internally it alternates from splendent to glistening, and the lustre is metallic.

The fracture is more or less perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is completely opaque.

It is harder than felspar.

It is brittle.

It retains its colour in the streak.

Specific gravity 4.5, 4.650, *Klaproth.*

Chemical Characters.

Before the blowpipe, it melts into a blackish-brown coloured glass, which is slightly attracted by the magnet. The

The mineral acids have no sensible effect on it; but the acid of sugar extracts a portion of the titanium.

Constituent Parts.

Oxide of Titanium,	48	28
Oxide of Iron, -	48	72
Oxide of Uranium, -	4	
	100	100
	Thomson, in Edin. Phil. Trans. for 1807.	*Klaproth*, Beit. b. v. s. 206.

Geognostic and Geographic Situations.

It occurs imbedded in gneiss, and disseminated in granitic sand, along with iron-sand, in the bed of the river Don in Aberdeenshire *. On the Continent of Europe, it has been hitherto found only in the lofty Riesengebirge, near the origin of the stream called the Iser, disseminated in granite-sand †, and in alluvial soil, along with pyrope, in Bohemia.

Observations.

* Vid. Dr Thomson's Paper on the Black Sand of the river Don in Aberdeenshire.—Edin. Phil. Trans.

† The Buchberg is the highest basalt hill in Germany, being 2921 feet above the level of the sea, and the highest basalt except that small portion lodged in the cavity of the Schneegrube, which is situated near 4000 feet above the level of the sea. The hill itself is elevated 500 feet above the level of the stream named Iser, that waters its granite base, and at some distance below which the Iserine is found. Whilst travelling through Silesia with that excellent and truly philosophical mineralogist, my amiable, and ever to be regretted friend, the late Dr Mitchell, we ascended the Buchberg, with the view of ascertaining more particularly the geognostic situation of the Iserine; but after a very careful examination, we could discover it neither in the granite nor basalt, but only loose in the granitic sand.

Observations.

1. This mineral is by many mineralogists, and probably with justice, referred to the magnetic iron-sand.

2. Its fracture distinguishes it from *Menachanite*.

Third Subspecies.

Menachanite.

Menacan, *Werner*.

Menachanite, *Kirw*. vol. i. p. 326.—Le Menakanite, *Broch*. t. ii. p. 468.—Titane oxidé ferrifere granuliforme, *Haüy*, t. iv. p. 306.—Manacan, *Reuss*, b. iv. s. 54. *Id. Lud.* b. i. s. 305. *Id. Mohs*, b. iii. s. 452. *Id. Leonhard*, Tabel. s. 81.—Titane Menakanite, *Brong*. t. ii. p. 99.—Manakan, *Karsten*, Tabel. s. 74.—Menachanite, *Kid*, vol. ii. p. 224.—Titane oxidé ferrifere, *Haüy*, Tabl. p. 116.—Titaneisenstein, *Haus*. Handb. b. i. s. 251.—Menakan, *Hoff*. b. iv. s. 247.—Menachanite, *Aikin*, p. 136.

External Characters.

Its colour is greyish-black, inclining to iron-black.

It occurs only in very small flattish angular grains, which have a rough glimmering surface.

Internally it is glistening or glimmering, or the lustre is adamantine, passing into semi-metallic.

It has an imperfect cleavage.

The fragments are indeterminate angular and sharp-edged.

It is perfectly opaque.

It

It is not so hard as magnetic iron-sand.
It is brittle, and easily frangible.
It retains its colour in the streak.
Specific gravity, 4.427, *Gregor.*—4.270, *Lampadius.*

Physical Character.

It is attractible by the magnet, but in a much weaker degree than magnetic ironstone.

Chemical Characters.

It is infusible, without addition, before the blowpipe: it tinges borax of a greenish colour, which inclines to brown.

Constituent Parts.

	Cornwall.	Botany Bay
Oxide of Iron, -	51.00	49
Oxide of Titanium,	45.25	40
Oxide of Manganese,	0.25	
Silica,	3.50	11
	100.00	100
	Klaproth, Beit. b. ii. s. 231.	*Chenevix*, in Nicholson's Journ. vol. v p. 132.

Geognostic and Geographic Situations.

It is found, accompanied with fine quartz-sand, in the bed of a rivulet which enters the valley of Manaccan in Cornwall; on the shores of the Island of Providence in America; the vicinity of Richmond in Virginia; and at Botany Bay in New South Wales.

Observations.

Observations.

It has been confounded with Magnetic Iron-Sand, from which it may be readily distinguished by its cleavage, lustre and inferior hardness; and its inferior hardness and weight distinguish it from *Tinstone*.

3. Pyramidal Titanium-Ore, or Octahedrite.

Octaedrit, *Werner*.

Schorl bleu, *Romé de Lisle*, t. ii. p. 406.—Schorl octaedre rectangulaire, *Bournon*, Journ. de Phys. 1787, Mai.—Oisanite, *Lam*. t. ii. p. 269.—Octaedrite, *Saussure*, Voyages dans les Alpes, t. vii. p. 139. § 1901.—Anatase, *Haüy*, t. iii. p. 129. 136. *Id. Broch*. t. ii. p. 548. *Id. Reuss*, b. iv. s. 580.—Pyramiden Manak, *Lud*. b. ii. s. 191.—Anatase-titan, *Suck*. 2ter th. s. 480.—Anatase, *Mohs*, b. iii. s. 462. *Id. Leonhard*, Tabel. s. 82.—Titane-Anatase, *Brong*. t. ii. p. 101.—Anatas, *Karsten*, Tabel. s. 74. *Id. Haus*. s. 111.—Octahedral Titanite, *Kid*, vol. ii. p. 223.—Titan anatase, *Haüy*, Tabl. p. 116.—Anatas, *Haus*. Handb. b. i. s. 322.—Octaedrit, *Hoff*. b. iv. s. 249.—Octohedrite, *Aikin*, p. 137.

External Characters.

Its colour passes from indigo-blue, through many shades, to dark reddish-brown, clove-brown, and yellowish-brown.

It has been hitherto found only crystallized.

Its primitive form is a pyramid of 97° 38′, and 137° 10′ *. The following are the secondary figures:

The

* Anatase primitif, Haüy.

1. The pyramid truncated on the extremities *.
2. Double four-sided pyramid acuminated on the extremities with four planes, and the acuminating planes set on the lateral planes †.
3. Double four-sided pyramid acuminated with eight planes, of which two and two are set on each lateral plane ‡.

The crystals are small and very small, and are usually superimposed.

The surface is transversely streaked, and is splendent, and the lustre is semi-metallic.

Internally it is also splendent, and the lustre is adamantine, inclining to semi-metallic.

It has a fourfold cleavage parallel with the sides of the primitive figure, and one cleavage parallel to the common base of the pyramids.

The fragments are indeterminate angular and sharp-edged.

It is strongly translucent or semi-transparent, or passing to transparent.

It is harder than apatite, and sometimes nearly as hard as felspar.

It is brittle.

Specific gravity, 3.8571, *Haüy*.—3.8, 3.9, *Mohs*.

Chemical Characters.

It is infusible before the blowpipe. When melted with borax, a reddish-brown coloured glass is formed. When this

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* Anatase basé, Haüy.

† Anatase dioctaedre, Haüy.

‡ Anatase prominulé, Haüy.

this glass is brought to the extremity of the flame, the reddish-brown colour changes into blue, and becomes opaque. If the action of the blowpipe be still continued, it at length becomes white. In a higher temperature, the reddish-brown colour again appears; and according as the temperature is altered, the appearance and disappearance of the colours can be produced.

Constituent Parts.

According to the experiments of Vauquelin, it is an oxide of titanium.

Geognostic and Geographic Situations.

It is a rare mineral. It is found at Bourg d'Oisans in Dauphiny, in veins in primitive rocks along with felspar, axinite, rock-crystal, and chlorite: it has also been met with in drusy cavities in transition clay-slate in Hadeland in Norway; and associated with rose-red fluor in St Gothard in Switzerland.

Observations.

1. It is distinguished from *Tungsten* by its lustre, greater hardness, and inferior specific gravity; and from *Axinite*, by its crystallizations, cleavage, and hardness.

2. It is named *Oisanite* by La Methrie, and *Anatase* by Haüy.

GEN. II.

GENUS II.—RED COPPER-ORE.

THIS Genus contains but one species, viz. Octahedral Red Copper-Ore.

1. Octahedral Red Copper-ore.

Octaedrisches Kupfer-erz, *Mohs.*

This Species is divided into four subspecies, viz. Foliated Red Copper-ore, Compact Red Copper-ore, Capillary Red Copper-ore, and Tile-ore. * Black Copper or Black Oxide of Copper.

First Subspecies.

Foliated Red Copper-Ore.

Blättriches Rothkupfererz, *Werner.*

Id. Werner, Pabst. b. i. s. 66.—Foliated florid-red Copper-ore, *Kirw.* vol. ii. p. 136.—Blätteriges Rothkupfererz, *Estner,* b. iii. s. 533. *Id. Emm.* b. ii. s. 214.—Le Cuivre Oxide rouge lamelleux, *Broch.* t. ii. p. 183.—Blättriches Rothkupfererz, *Reuss,* b. iii. s. 436. *Id. Lud.* b. i. s. 226. *Id. Suck.* 2ter th. s. 189. *Id. Bert.* s. 382. *Id. Mohs,* b. iii. s. 213. *Id. Leonhard,* Tabel. s. 56.—Cuivre oxydulé crystallisé, *Brong.* t. ii. p. 219.—Blættriches Rothkupfererz, *Karsten,* Tabel. s. 62.—Blättriges Rothkupfererz, *Hoff.* b. iii. s. 90. *Id. Haus.* Handb. b. i. s. 238.—Cuivre oxidulé lamellaire, *Haüy,* Tabl. p. 88. —Red Copper-ore, *Aikin,* p. 88.

External

External Characters.

Its colour is dark cochineal-red, which sometimes inclines to lead-grey; but the crystals are redder, and sometimes pass into dark carmine-red.

It occurs massive, disseminated, in membranes, corroded; also in coarse and fine angulo-granular concretions; and crystallized in the following figures:

1. Perfect octahedron, which is the primitive figure, fig. 171. Pl. 9. Sometimes two opposite planes become so large in comparison of the others, that a *six-sided table* is formed, fig. 172. Pl. 9.: in other instances, two opposite planes entirely disappear, when an *acute rhomboidal* figure is formed, fig. 173. Pl. 9.; and frequently the octahedron ends in a line, fig. 174. Pl. 9.
2. Octahedron truncated on the angles, fig. 175. Pl. 9. When the truncating planes become so large that the original planes of the octahedron disappear, a *cube* is formed, fig. 176. Pl. 9.
3. Octahedron truncated on all the edges, fig. 177. Pl. 9. When these truncating planes become so large as to cause the original planes to disappear, a *rhomboidal dodecahedron* is formed, fig. 178. Pl. 9. When the edges of the common basis of the octahedron are deeply truncated, the figure thus formed might be described as a rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes. In the same figure, the angles are also frequently truncated.

4. Octahedron,

4. Octahedron, in which each of the angles is acuminated with four planes, which are set on the lateral edges, fig. 179. Pl. 9.; sometimes the edges are truncated, and also the summits of the acuminations, fig. 180. Pl. 9.
5. Octahedron, bevelled on the edges, fig. 181. Pl. 9.: sometimes the bevelling planes become so large that each face of the octahedron appears divided into three compartments, or each plane supports a flat three-planed acumination, fig. 182. Pl. 9. Sometimes the angles and edges of the octahedron in this figure are also truncated, and according as these bevelling and truncating planes are larger or smaller, the figure varies in appearance.
6. Octahedron, in which each angle is acuminated with four planes, which are set on the lateral planes, fig. 183. Pl. 9. This variety is generally combined with the planes of several of the preceding ones.
7. Octahedron, in which each angle is acuminated with eight planes, two of which are set on each plane, fig. 184. Pl. 9. This variety is always associated with some of the preceding, and crystals have been met with, exhibiting this variety combined with all the preceding ones. Fig. 185. Pl. 9. represents such a crystal, which is marked as follows:— P, planes of the octahedron: (1.) Truncations on the angles: (2.) Truncations on the edges: (3.) Four acuminating planes on the angles, which are set on the edges of the octahedron: (4. Bevelling planes on the edges: (5.) Four acuminating planes

on

on the angles, which are set on the planes of the octahedron: (6.) Eight-planed acumination *.

The crystals are usually small and very small, seldom middle-sized: they occur sometimes aggregated on one another, side by side, and scalarwise.

The planes are smooth and splendent.

Internally it alternates from shining to glistening, and its lustre is adamantine, inclining to semi-metallic.

It has a fourfold cleavage, in which the folia are parallel with the sides of the octahedron.

The fracture is coarse and small-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

The massive varieties are usually opaque, or very faintly translucent on the edges. The crystals are transparent and semi-transparent, and sometimes strongly translucent.

It yields a muddy tile-red streak.

Its hardness is intermediate between that of calcareous-spar and fluor.

It is brittle, and easily frangible.

Specific gravity, 5.600, *Phillips.*—5.691, *Lowry.*—5.6, 6.0, *Mohs.*

Observations.

This subspecies is distinguished from the others by crystallization, lustre, cleavage, and translucency.

Second

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* The various forms, and numerous intermediate ones, are delineated in a set of plates attached to Mr Phillips valuable Memoir on Red Copper-ore, in the first volume of the Transactions of the Geological Society of London.

Second Subspecie

Compact Red Copper-Ore.

Dichtes Rothkupfererz, *Werner*.

Id. Werner, Pabst. b. i. s. 66.—Compact florid, or Cochineal-red Copper-Ore, *Kirw.* vol. ii. p. 135.—Dichtes Rothkupfererz, *Estner*, b. iii. s. 530. *Id. Emm.* b. ii. s. 213.—Le Cuivre Oxide rouge compacte, *Broch.* t. ii. p. 181.—Dichtes Rothkupfererz, *Reuss*, b. iii. s. 433. *Id. Lud.* b. i. s. 226. *Id. Suck.* 2ter th. s. 189. *Id. Bert.* s. 380. *Id. Mohs*, b. iii. s. 213. *Id. Leonhard*, Tabel. s. 56.—Cuivre oxidulé compact, *Brong.* t. ii. p. 219.—Dichtes Rothkupfererz, *Karsten*, Tabel. s. 62.—Red Oxide of Copper, *Kid*, vol. ii. p. 101.—Cuivre oxidulé massif, *Haüy*, Tabl. p. 38.—Dichtes Rothkupfererz, *Haus.* Handb. b. i. s. 239. *Id. Hoff.* b. iii. s. 95.—Amorphous Red Copper, *Aikin*, p. 88.

External Characters.

Its colour is intermediate between lead-grey and cochineal-red, often passing into dark cochineal-red.

It occurs massive, disseminated, and in a kind of reniform shape.

Internally it is glimmering, inclining to glistening, and the lustre is semi-metallic.

The fracture is even, inclining to flat conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It gives a tile-red streak, and loses thereby a little of its lustre.

It

It is as hard as the foliated subspecies.

It is brittle, and easily frangible.

Third Subspecies.

Capillary Red Copper-Ore.

Haarförmiges Roth Kupfererz, *Werner.*

Kupferblüthe, *Werner,* Pabst. b. i. s. 68.—Fibrous red Copper-ore, *Kirw.* vol. ii. p. 137.—Kupferblüthe, *Estner,* b. iii. s. 538. *Id. Emm.* b. ii. s. 216.—Le Cuivre Oxide rouge capillaire, *Broch.* t. ii. p. 184.—Haarförmiger Rothkupfererz, *Reuss,* b. iii. s. 439. *Id. Lud.* b. i. s. 227. *Id. Suck.* 2ter th. s. 194. *Id. Bert.* s. 382. *Id. Mohs,* b. iii. s. 226. *Id. Leonhard,* Tabel. s. 56.—Cuivre oxidulé capillaire, *Brong.* t. ii. p. 219.—Haarförmiges Rothkupfererz, *Karsten,* Tabel. s. 62. *Id. Haus.* Handb. b. i. s. 239. *Id. Hoff.* b. iii. s. 97.—Cuivre oxydulé capillaire, *Haüy,* Tabl. p. 88.—Capillary Red Copper, *Aikin,* p. 88.

External Characters.

Its colour is most commonly carmine-red, which becomes paler by keeping.

It occurs in small capillary crystals, also in thin tables, which are sometimes aggregated into amorphous and scopiform flakes.

It is shining, and the lustre is adamantine.

It is translucent; but its internal aspect, and the other external characters, cannot be determined, on account of the smallness of the parts of the mineral.

Chemical Characters of the Species.

It is easily reduced to the metallic state before the blow-pipe: if pulverised, and thrown into nitric acid, a violent effervescence ensues, and the copper is dissolved, the solution at the same time acquiring a green colour; but if thrown into muriatic acid, no effervescence takes place. We can by this character distinguish red copper-ore from red silver-ore and cinnabar: red silver-ore does not effervesce in nitric acid; and cinnabar does not dissolve in it. It is soluble in ammonia, to which it communicates a blue colour.

Constituent Parts.

	Cornwall.	Siberia.
Copper,	88.5	91.0
Oxygen,	11.5	9.0
	100.0	100.0
	Chenevix, Phil. Trans. for 1801.	*Klaproth*, Beit. b. iv. s. 29.

	Foliated, Siberia.	Compact Siberia.
Red Oxide of Copper,	97.55	99.50
Intermixed Copper,	1.45	......
Water, - -	0.75	0.25
Oxide of Iron, -	0.25	0.25
	100.00	100.00

John, Chem. Unter. b. i. s. 264. & 261.

Geognostic Situation of the Compact and Foliated Subspecies.

It occurs principally in veins that traverse primitive, and sometimes transition rocks, rarely in secondary rocks, and but seldom in beds, along with copper-glance or vitreous copper. In the veins, it is associated with native copper, blue copper, malachite, copper-green, tile-ore, copper-glance or vitreous copper-ore, copper-pyrites, copper-black or black oxide of copper, olivenite, cube-ore or hexahedral olivenite, arsenical-pyrites, and brown iron-ore. The veinstones are,

quartz,

quartz, fluor-spar, calcareous-spar, heavy-spar, and occasionally chlorite and mica.

Geographic Situation of the Foliated and Compact Subspecies.

Europe.—It occurs in different veins in the mine of Huel-Gorland in Cornwall. All the veins traverse granite, and three of them, viz. the North Lode, the Great Gossan Lode, and the Muttrel Lode, afford the red copper-ore. In the North Lode, it is associated with fluor-spar. In the Great Gossan Lode, it occurs in considerable quantity, and occasionally intermixed with native copper: higher up in the same vein, there is abundance of fluor-spar, sometimes intermixed with copper-pyrites, and arsenical-pyrites. In the Muttrel Lode, the red copper-ore is occasionally accompanied with copper-glance or vitreous copper-ore, copper-black or black oxide of copper, olivenite, arsenical-pyrites, quartz, and fluor-spar. Native copper also occurs in considerable quantities, and generally intermixed with red copper-ore *. It is also found in the mines of Carvath and Huel-Prosper, also in Cornwall. Small portions of this ore occur, along with native copper, in the trap-rocks of Nalsoe, one of the Faroe Islands; also in the mine of Aardal in Norway, and that of Garpa, in East Gothland in Sweden. It occurs but sparingly, and along with native copper, in the Rammelsberg in the Hartz; near Freyberg, along with native copper, ochry brown iron-ore, lamellar heavy-spar, and quartz; at Altenkirchen, along with brown hematite, native copper, malachite, olivenite, and quartz; in the Zillerthal in Bavaria; distinct crystals, imbedded in secondary

* Phillips, in Geological Transactions, vol. i. p. 23.—29.

secondary rocks, at Chessy, near Lyons in France; at Ensiedel in Hungary, with native copper, copper and iron pyrites; at Saska and Moldowa in the Bannat, associated with copper-glance or vitreous copper-ore, malachite, blue copper, native copper, and brown iron-ore.

Asia.—In the mines of Kolywan, along with native copper, and various ores of that metal; and in different mines in the Uralian Mountains.

America.—Chili and Peru.

Geognostic and Geographic Situations of the Capillary Subspecies.

The preceding account applies to the Compact and Foliated red copper-ores: the third subspecies, the Capillary ore, occurs less frequently. In Cornwall, it is found in Huel-Gorland, St Day, and Carharrack mines. On the Continent of Europe, beautiful specimens are met with at Rheinbreitenbach in Nassau, where it is associated with ochry brown iron-ore, native copper, copper-green, malachite, copper-pyrites, white lead-spar, phosphate of copper, copper-black or black oxide of copper, and quartz, in veins that traverse grey-wacke; at Saska in the Bannat, with brown iron-ore, malachite, tile-ore, native copper, foliated red copper-ore, steatite, and lithomarge; and also in the Saxon Erzgebirge, as at Freyberg and Glasshütte. It is also a production of the Siberian copper-mines.

Uses.

It is valued as an ore of copper.

Observations.

1. It is distinguished from *Copper-glance* or *Vitreous Copper*, by its colour; from *Red Silver*, by its crystallizations,

tions, brittleness, greater hardness, and accompanying minerals: from *Cinnabar*, by its colour, brittleness, greater hardness, weight and accompanying minerals: from *Red Antimony-ore* by its colour, red antimony having a cherry-red colour.

2. It is the richest ore of copper.

3. It is described by Cronstedt under the name *Kupferglas*.

4. Hausmann, in his Handbuch der Mineralogie, describes in the following manner a fourth subspecies of red copper-ore:

Earthy Red Copper-ore.

Erdiges Kupferroth.

The colour is intermediate between cochineal-red and brick-red. It occurs massive, and incrusting other ores. It is fine earthy, and dull. It is associated with malachite, tile-ore, native copper, and brown ironstone. It occurs in veins, probably also in beds, in primitive and transition rocks. It is a rare mineral, and has been hitherto found only at Rheinbreitenbach; and near Lauterberg in the Hartz.

Fourth Subspecies.

Tile-Ore.

Ziegelerz, *Werner*.

This subspecies is divided into two kinds, viz. Earthy Tile-ore, and Indurated Tile-ore.

First

First Kind.

Earthy Tile-Ore.

Erdiches Ziegelerz, *Werner.*

Id. Wern. Pabst. b. i. s. 70.—Earthy Brick-red Copper-ore, *Kirw.* vol. ii. p. 137.—Erdiges Ziegelerz, *Estner,* b. iii. s. 550. *Id. Emm.* b. ii. s. 219.—Le Ziegelerz terreuse, *Broch.* t. ii. p. 187.—Erdiges Ziegelerz, *Reuss,* b. iii. s. 448. *Id. Lud.* b. i. s. 227. *Id. Suck.* 2ter th. s. 194. *Id. Bert.* s. 382. *Id. Mohs,* b. iii. s. 226. *Id. Leonhard,* Tabel. s. 56.—Cuivre oxidulé ferrifere, *Brong.* t. ii. p. 220.—Erdiges Ziegelerz, *Karsten,* Tabel. s. 62.—Earthy Red Oxide of Copper, mixed with Brown Oxide of Iron, *Kid,* vol. ii. p. 105.—Cuivre oxydulé terreuse, *Haüy,* Tabl. p. 88.—Erdiges Kupferbraun, *Haus.* Handb. b. i. s. 241.—Erdiges Ziegelerz, *Hoff.* b. iii. s. 99.—Ferruginous Red Copper, *Aikin,* p. 88.

External Characters.

Its colour is hyacinth-red, sometimes also brownish-red, which passes into a reddish-brown, that borders on yellowish-brown.

It occurs massive, disseminated, and incrusting copper-pyrites.

It is composed of dull dusty particles, which are more or less cohering.

It soils slightly, and feels meagre.

Geognostic Situation.

It occurs in veins, and is usually accompanied with native copper and malachite, and sometimes with red copper-ore.

Geographic

Geographic Situation.

It is found at Lauterberg in the Hartz; in veins in the Bannat, along with copper-pyrites, red copper-ore, grey copper, ironshot copper-green, malachite, native copper, and ochry iron-ore; at Falkenstein in the Tyrol, with copper-green, malachite, grey copper, blue copper, calcareous-spar, and quartz; and at Rezbanya, along with copper-green, malachite, and calcareous-spar.

Second Kind.

Indurated Tile-Ore.

Festes Ziegelerz, *Werner.*

Minera Cupri picea, *Wall.* t. ii. p. 280.—Dichtes Ziegelerz, *Werner,* Pabst. b. i. s. 70.—Indurated Brick-red Copper-ore, *Kir.* vol. ii. p. 138.—Pecherz, *Estner,* b. iii. s. 553.—Ziegelerz *Emm.* b. ii. s. 220.—Le Ziegelerz endurcé, *Broch.* t. ii. p. 188. —Verhärtetes Ziegelerz, *Reuss,* b. iii. s. 444. *Id. Lud.* b. i. s. 228. *Id. Suck.* 2ter th. s. 196. *Id. Bert.* s. 383. *Id. Mohs,* b. iii. s. 229. *Id. Leonhard,* Tabel. s. 56. *Id. Karsten,* Tabel. s. 62. *Id. Hoff.* b. iii. s. 100.—Muschliches Kupferbraun, *Haus.* Handb. b. i. s. 241.

External Characters.

Its colours are dark hyacinth-red, brownish-red, reddish-brown, from which it passes into blackish-brown, and dark steel-grey; also dark clove-brown, yellowish-brown, and brownish-black.

It occurs massive, disseminated; also in curved lamellar and fibrous concretions.

Internally

Internally it is glimmering, seldom glistening, and is resinous.

The fracture is imperfect and flat conchoidal.

The fragments are indeterminate angular, and more or less sharp-edged.

The streak is feebly shining, and somewhat lighter in the colour.

It is intermediate between semi-hard and soft.

It is rather brittle, and rather easily frangible.

Chemical Characters.

Before the blowpipe it becomes black, but is very difficultly fusible. To borax it communicates a muddy green colour.

Constituent Parts.

Werner considers it to be an intimate combination of red copper-ore and brown iron-ochre. It contains from 10 to 50 *per cent.* of copper.

Geognostic Situation.

It occurs in veins, and is usually accompanied with red copper-ore, native copper, copper-pyrites, fibrous malachite, and brown iron-ochre.

Geographic Situation.

Europe.—It occurs in veins, along with red copper-ore, native copper, copper-pyrites, and other ores, in Huel-Gorland in Cornwall; also at Llanymynich Hill in Shropshire; at Aardals copper-mine in Norway, along with compact malachite and native copper; at Lauterberg in the Hartz; Kupferberg in Silesia; Rheinbreitenbach in Nassau, along

along with copper-pyrites, malachite, blue copper, copper-green, &c.; Saxon Erzgebirge; and Thuringia; at Falkenstein in the Tyrol, particularly the variety named Pecherz or Pitch-ore; Iglo, Rezbanya, and the Bannat in Hungary.

Asia.—In the mines of Frolowskoi, along with red copper-ore, and brown iron-ochre.

America.—In the mine of El Rosario in Mexico, associated with copper-green and copper-pyrites.

Observations.

1. The red varieties contain the greatest quantity of copper, and the brown the greatest quantity of iron.

2. It is rather a common ore of copper, and occurs almost always where red copper is found.

3. It passes, by increase of the quantity of brown iron-ochre, into brown ironstone.

4. The dark-brown variety of indurated tile-ore, on account of the resemblance of its fracture to pitch, has been denominated *Pitchore*, (Pecherz).

* Black Copper, or Black Oxide of Copper.

Kupferschwärze, *Werner.*

Ochra Cupri nigra, *Wall.* t. ii. p. 291.—Kupferschwärtze, *Wern.* Pabst. b. i. s. 88. *Id. Wid.* s. 755.—Black Copper-ore, *Kirw.* vol. ii. p. 143.—Kupferschwärtze, *Emm.* b. ii. s. 244. *Id. Estner,* b. iii. s. 525.—Oxide noire de Cuivre, *Lam.* p. 312.—Le Cuivre noire, *Broch.* t. ii. p. 180.—Kupferschwärze, *Reuss,* b. iii. s. 431. *Id. Lud.* b. i. s. 226. *Id. Suck.* 2ter th. s. 188. *Id. Bert.* s. 379. *Id. Mohs,* b. iii. s. 229. *Id. Leonhard,* Tabel. s. 58.

s. 58. *Id. Karsten,* Tabel. s. 62. *Id. Haus.* Handb. b. i. s. 243. *Id. Hoff.* b. iii. s. 133.—Black Copper, *Aikin,* p. 89.

External Characters.

Its colour is usually intermediate between bluish and brownish-black, but rather more inclining to brownish-black.

It occurs massive, sometimes disseminated, and thinly coating copper-pyrites, and other ores of copper.

It is composed of dull dusty particles, which scarcely soil.

It is always more or less cohering.

It becomes slightly shining in the streak *.

Chemical Characters.

Before the blowpipe it emits a sulphureous odour, melts into a slag, and communicates a green colour to borax. It forms a smalt-blue coloured solution with ammonia, the iron remaining undissolved.

Constituent Parts.

It is said to be an Oxide of Copper.

Geognostic Situation.

It occurs usually with copper-pyrites, malachite, copper-green, and copper-glance or vitreous copper-ore; sometimes with native copper, red copper-ore, grey copper, blue copper-ore, quartz, fluor-spar, heavy-spar, and brown-spar.

Geographic

* Bournon, in his *Catalogue Mineralogique*, says, that this ore is sometimes reniform, with a fibrous fracture like hæmatite.

Geographic Situation.

Europe.—It occurs at Carrarach and Tincroft mines in Cornwall; in veins in transition rocks in the Hartz; in the mines of Moss and Arendal in Norway; near Freyberg, in veins, along with grey copper, copper-pyrites, ochry brown iron-ore, and quartz; near Schwatz in the Tyrol, along with copper-pyrites, grey copper, malachite, and copper-green; at Kupferberg and Rudelstadt in Silesia; Markirch in Alsace; in the Schwarzwald; and also in Hungary.

Asia.—Along with iron-pyrites at Schlangenberg; and in different mines in the Uralian Mountains.

Observations.

1. It appears to be formed, sometimes by the decomposition of copper-pyrites and copper-glance or vitreous copper-ore, and in other instances to be an original formation.

2. It is placed after Red Copper-ore, but not inserted in the genus, until its characters shall be better ascertained.

GENUS III. TIN-ORE.

Zinnerz, *Mohs.*

THIS Genus contains one Species, viz. Pyramidal Tin-Ore.

1. Pyramidal Tin-Ore.

Pyramidales Zinnerz, *Mohs.*

THIS Species is divided into two Subspecies, viz. Common Tin-Ore or Tinstone, and Cornish Tin-Ore.

First

First Subspecies.

Common Tin-Ore or Tinstone.

Zinnstein, *Werner*.

Stannum Arsenico et Ferro mineralisatum, *Wall.* t. ii. p. 319. *et seq.*—Zinnstein, *Werner,* Pabst. b. i. s. 171. *Id. Wid.* s. 880.—Common Tin-stone, *Kirw.* vol. ii. p. 197.—Etain vitreux, *De Born,* t. ii. p. 238.—Zinnkies, *Emm.* b. ii. s. 420. —Oxide d'Etain, *Lam.* t. i. p. 274.—Etain oxidé, *Haüy,* t. iv. p. 137.—La Pierre d'Etain, ou la Mine d'Etain commune, *Broch.* t. ii. p. 334.—Zinnstein, *Reuss,* b. iv. s. 288. *Id. Lud.* b. i. s. 267. *Id. Suck.* 2ter th. s. 354. *Id. Bert.* s. 441. *Id. Mohs,* b. iii. s. 596.—Etain oxidé, *Lucas,* p. 150.—Zinnstein, *Leonhard,* Tabel. s. 75.—Etain oxydé, *Brong.* t. ii. p. 189. *Id. Brard,* p. 335.—Zinnstein, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 110.—Etain oxidé, *Haüy,* Tabl. p. 101.—Native Oxyd of Tin, *Kid,* vol. ii. p. 147.—Zinnstein, *Haus.* Handb. b. i. s. 314. *Id. Hoff.* b. iv. s. 56.—Tinstone, *Aikin,* p. 116.

External Characters.

Its most common colour is blackish-brown; from which it passes, on the one side, into brownish-black, velvet-black, and greyish-black, on the other side, into hair-brown, clove-brown, and reddish-brown; from which it passes further into yellowish-brown, yellowish-green, yellowish-grey, yellowish-white, and greenish-white; from yellowish-grey it passes into cream-yellow, wine-yellow, and hyacinth-red.

It occurs massive, disseminated, in rolled pieces, in grains, in granular distinct concretions, but most frequently crystallized, and in the following figures:

1. The

1. The primitive figure is a double four-sided pyramid, in which the angles are 133° 36′ and 67° 42′, Fig. 186. Pl. 9. The following are some of the secondary figures:

   This figure is rarely perfect, being usually more or less deeply truncated on the edges of the common base, and sometimes the edge of the base is bevelled, and the edge of the bevelment truncated. The angles on the common base, and also of the summits, are occasionally truncated.

2. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral planes *, Fig. 187. Pl. 9.

3. The preceding figure, in which the lateral edges, and also those formed by the meeting of the acuminating planes, are truncated †. Fig. 188. Pl. 9. Sometimes in the same figure, the edges formed by the meeting of the acuminating planes are truncated, and the lateral edges are bevelled, and the bevelling edges truncated ‡. Fig. 189. Pl. 9.

4. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges ||. Fig. 190. Pl. 9.

5. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges, and the edges formed by the meeting of the acuminating and lateral planes truncated §. Fig. 191. Pl. 9.

When

---

* Etain oxydé pyramidé, Haüy.

† Etain oxydé equivalent, Haüy.

‡ Etain oxydé soustractif, Haüy.

|| Etain oxydé dodecaedre, Haüy.

§ Etain oxydé recurrent, Haüy.

When these truncating planes on the edges become very large, an eight-planed acumination is formed, as is represented in the following figure.

6. Long rectangular four-sided prism, acutely acuminated on both extremities with eight planes, of which two and two always meet together, under very obtuse angles, and are set on the lateral planes; and again flatly acuminated with four planes, which are set on the obtuse edges of the first acumination *, Fig. 192. Pl. 10. The edges of the second acumination are sometimes truncated †.

7. Twin-crystals of various descriptions; but of these the most frequent is that formed by the junction of two crystals, of the variety No. 2. which is represented in Fig. 193. Pl. 10 ‡.

The twin-crystal here figured, is one of the most common forms of the species.

The surface of the crystals is usually smooth, seldom more or less strongly streaked, and it is commonly splendent.

Internally it alternates from splendent to glistening, and the lustre is intermediate between resinous and adamantine, but more inclining to the latter.

In

---

* Etain oxydé opposite, Haüy.

† Etain oxydé distique, Haüy.

‡ The most complete account of the various crystallizations of tin-ore we possess, is that by Mr William Phillips, in the second volume of the Transactions of the Geological Society of London. His memoir is accompanied with a series of beautiful plates, of which I could not avail myself in this work, because of their number and minuteness.

In some varieties a cleavage is to be observed; two cleavages are in the direction of the lateral planes of the rectangular four-sided prism, and other two in the direction of the diagonals of the same prism.

The fracture is coarse and small-grained uneven, inclining to imperfect conchoidal.

The fragments are indeterminately angular, and rather blunt-edged.

It alternates from semi-transparent to opaque; the darker coloured varieties are opaque, the lighter translucent and semi-transparent, often even inclining to transparent; the intermediate varieties are only translucent and translucent on the edges.

It yields a greyish-white streak.

It is as hard as felspar, and sometimes even equal in hardness to quartz.

It is easily frangible, and brittle.

Specific gravity, 6.3, 7.0, *Mohs.*—6.300 to 6.989, *Gellert.*—6.750, *Brunnich.*—6.880, *Leysser.*—6.9009, the black, 6.9348, the red, *Brisson.*—5.845 to 6.970, *Klaproth.*

Chemical Characters.

Before the blowpipe it decrepitates, and becomes paler; when finely pounded, it is reducible on charcoal by the continued action of the blowpipe, to the metallic state. Acids dissolve the iron it contains, but only a very minute portion of the tin.

Constituent

Constituent Parts.

	From Alternon.	Schlackenwald.	Ehrenfriedersdorf.
Tin, -	77.50	75.00	68
Iron, -	0.25	0.50	9
Oxygen, -	21.50	24.50	16
Silica, -	0.75	......	7
	100	100	100

Klaproth, Beit. b. ii. s. 256. *Lampadius.*

Oxide of Tin, -	94.50
Oxide of Iron, -	1.00
Oxide of Manganese,	0.50
Silica, - -	1.00
Alumina, - -	3.00
	100

John, Chem. Unters. b, ii. s. 242.

	Zinnwald.
Oxide of Tin,	97.15
Oxide of Iron,	00.35
Alumina, -	2.50
	100

Kastner, Beit. z. Begrundung einer Wissench. Chem. b. . s. 26.

Geognostic Situation.

It occurs disseminated, in beds, in imbedded masses, and veins, in granite, gneiss, mica-slate, clay-slate, porphyry, and in an alluvial form, in what are in Cornwall named *Stream Works.* It is associated with wolfram, tungsten, molybdena, arsenical pyrites, copper-pyrites, specular iron-ore, blende, rock-crystal, topaz, shorl, hornblende, chlorite, mica, steatite and fluor-spar; less frequently with calcareous-spar, heavy-spar, and with ores of lead, silver, and iron.

Geographic Situation.

Europe.—Tin is not found in many different countries, but when it does occur, it is generally in considerable quantity. There are only three principal tin districts in Europe.

rope. The first and most considerable is in Cornwall, where it occurs in veins, or disseminated in granite and slate, whether clay-slate or chlorite-slate. It is sometimes raised in large blocks; for we are informed by Mr Phillips, that one block raised from the mine called Polberrow in St Agnes's, weighed 1200 lb. and produced more than half that of pure metal. It is rarely found in massive portions, being generally crystallized; and it is worthy of notice, that all the varieties of form are not found indiscriminately in the same vein or set of veins, but appear rather to be distributed in different veins or sets of veins. Thus, according to Mr Phillips, the tin-mine of Penandrae, near Redruth, affords scarcely any other form but that of a particular kind of twin-crystal; the veins of Huel Fanny Mine, only three particular varieties of crystallization; and the tin-mine of Polgooth near St Austle, only minute crystals of one particular form. Of the same nature nearly is the observation, that certain varieties of calcareous-spar are peculiar to Derbyshire, others to particular districts in Saxony, and some are only met in particular mines in France or Spain. Alluvial depositions of tin-ore are met with of considerable extent and depth, in several parts of Cornwall; these are named *Stream Works*, because the tin is extracted from them by passing a stream of water across them. It is worthy of remark, that the only traces of gold hitherto met with in Cornwall are in the stream works, where it is found generally detached, and sometimes accompanied with quartz *.

The second tin district is situated in the Erzgebirge, both on the Bohemian and Saxon sides of that mountain group.

* For other particulars in regard to the Tin of Cornwall, I refer to Mr Phillips's paper, in the second volume of Transactions of Geological Society.

group. There it occurs disseminated on the granite, and in beds that alternate with that rock, where it is associated with wolfram, tungsten, common quartz, rock-crystal, mica, talc, fluor-spar, &c. in massive or crystallized forms. It often also occurs in veins in granite, gneiss, and mica-slate, and also in clay-slate. Alluvial deposites of this ore, resembling the stream-works of Cornwall, are also met with in these districts.

The third tin district is situated at Monte Rey in Gallicia in Spain, where the ore occurs in beds in mica-slate.

Very lately this ore has been found in small quantity in grains and crystals, in veins which traverse the granite hill of Puy les Vignes, in the vicinity of St Leonhard, in the department of Haut-Vienne in France, where it is associated with wolfram, arsenical-pyrites, and martial arseniate of copper.

Asia.—It does not appear that tin has hitherto been met with in any of our possessions in India. It is found on the east coast of Sumatra, of Siam, and of Pegu; but it is principally imported into our Indian Empire as an article of commerce from Queda, Junk-Ceylon, Tavai in Lower Siam *, and the Island of Banca. The tin mines of Banca are said to be of great extent, and Mr Ellmore informs us, that there are exported from them annually no less than from forty to sixty thousand peculs of tin. It is said also to occur at a place five days journey from Nankin, in the province of Kianfu in China †. It is reported that a rich tin mine has been opened on the Onon, on the frontier of China.

America.

* Vid. Franklin's Tracts "On the Dominions of Ava," p. 64.

† Sage, in Journ. de Phys. t. 54. p. 113.

America.—Tin-ore is found in Mexico, where it is extracted from alluvial deposites by means of washing, in the intendancy of Guanuaxuata and Zacatecas. It has been found in small quantity at Ivikaet in South Greenland.

Uses.

It is worked as an ore of tin, and nearly all the tin of commerce is obtained from it.

Observations.

It is distinguished from *Wolfram*, by its superior hardness, as it readily scratches wolfram, but wolfram does not affect it; and also by the streak, which is of a greyish-white colour, whereas that of wolfram is dark reddish-brown. It is distinguished from *Blende* by its superior hardness, and its not emitting a sulphureous odour when triturated; from *Garnet* by its resino-adamantine lustre, higher specific gravity, and inferior hardness; and from *Schorl* by colour, form, lustre, and higher specific gravity.

Second Subspecies.

Cornish Tin-Ore, or Wood-Tin.

Kornisch Zinnerz, *Werner.*

Mine d'Etain mamelonné, ou en Stalactites, *Romé de Lisle*, t. iii. p. 428.—Kornisch Zinnerz, *Werner*, Pabst. b. i. s. 183. *Id. Wid.* s. 877.—Wood Tin-ore, *Kirw.* vol. ii. p. 198.—Etain limoneux, *De Born*, t. ii. p. 248—Kornisch Zinnerz, *Emm.* b. ii. s. 427.—Mine d'Etain ferrugineux, *Lam.* t. i. p. 281.—Etain oxidé concretionné, *Haüy*, t. iv. p. 147.—La Mine d'Etain

d'Etain grenue, ou l'Etain grenu, *Broch.* t. ii. p. 340.—Holzzinnerz, *Reuss,* b. iv. s. 300. *Id. Lud.* b. i. s. 269. *Id. Suck.* 2ter th. s. 358.—Cornisch Zinnerz, *Bert.* s. 443. *Id. Mohs,* b. iii. s. 593.—Etain oxydé concretionné, *Lucas,* p. 150.—Holzzinnerz, *Leonhard,* Tabel. s. 75.—Etain oxydé concretionné, *Brong.* t. ii. p. 190. *Id. Brard,* p. 336.—Holzzinnerz, *Karsten,* Tabel. s. 70.—Fasriger Zinnstein, *Haus.* s. 110.—Etain oxidé concretionné, *Haüy,* Tabl. p. 102.—Kornisch Zinnerz, *Hoff.* b. iv. s. 53.—Fasriges Zinnstein, *Haus.* Handb. b. i. s. 317.—Wood-tin, *Aikin,* p. 116.

External Characters.

Its most common colour is hair-brown, of different degrees of intensity, which passes into wood-brown, yellowish-grey, and sometimes into reddish-brown. In single pieces it is occasionally striped in a concentric manner.

It occurs in rolled pieces, which are generally wedge-shaped; also reniform, botryoidal, and globular; in distinct concretions, which are scopiform and stellular delicate fibrous, and collected into others which are curved lamellar, and angulo-granular.

Externally it is glistening.

Internally it is feebly glistening or glimmering, and the lustre is resinous, inclining to pearly.

The fragments are wedge-shaped and splintery.

It is opaque.

It is rather softer than common tinstone.

Its streak is grey, inclining to brown.

It is brittle, and easily frangible.

Specific gravity, 6.450, *Klaproth*—6.302, *Breithaupt.*

Chemical Characters.

Before the blowpipe it becomes brownish-red, and decrepitates,

crepitates, but is not fused, or reduced to the metallic state: when strongly heated in a charcoal crucible, it affords about 73 *per cent.* of metallic tin.

Constituent Parts.

			Mexican.
Oxide of Tin,	-	91	95
Oxide of Iron,	-	9	5
		100	100

Vauquelin, N. Journ. d. Chem. b. v. s. 231. *Collet-Descotils*, Ann d. Chem. t. liii. p. 268.

Geognostic and Geographic Situations.

Europe.—It occurs loose, and in small quantities, along with stream tin, in alluvial deposites (stream-works), at Sithney, St Creet, Gossmoor, Pentowan, Gavrigan, St Mewan, St Columb, St Roach, and St Denis, in Cornwall.

America.—It is one of the most common ores of tin in Mexico. In that country, it is found at Guanuaxuato (Goanachuato), in veins that traverse trap-porphyry, and it is also met with in alluvial deposites *.

Observations.

It very much resembles *Brown Hematite*, but can be distinguished from it by its colour-suite, greater hardness, and higher specific gravity.

GENUS IV.

* Some time ago Mr Mawe of London sent me a drawing of a mass of Mexican wood-tin, now in his possession, which weighs ten ounces and a half. It is the largest specimen of this ore I am acquainted with.

GENUS IV. WOLFRAM.

Scheel-erz, *Mohs.*

THIS Genus contains one species, viz. Prismatic Wolfram.

1. Prismatic Wolfram.

Prismatisches Scheel-erz, *Mohs.*

Wolfram, *Werner.*

Magnesia cristallina; Spuma Lupi, *Wall.* t. ii. p. 344.—Wolfram, *Wern.* Pabst. b. i. s. 223. *Id. Wid.* s. 983. *Id. Kirw.* vol. ii. p. 316. *Id. De Born,* t. ii. p. 227. *Id. Emm.* b. ii. s. 574. *Id. Lam.* t. i. p. 404. *Id. Broch.* t. ii. p. 456.—Scheelen ferruginé, *Haüy,* t. iv. p. 314.—Wolfram, *Reuss,* b. iv. s. 541. *Id. Lud.* b. i. s. 303.—Eisen-Scheel, *Suck.* 2ter th. s. 461.—Wolfram, *Bert.* s. 509. *Id. Mohs,* b. iii. s. 618.—Scheelin ferruginé, *Lucas,* p. 182.—Wolfram, *Leonhard,* Tabel. s. 81.—Scheelin ferruginé, *Brong.* t. ii. p. 94. *Id. Brard,* p. 388.—Wolfram, *Karsten,* Tabel. s. 74.—Scheelin ferruginé, *Haüy,* Tabl. p. 118.—Wolfram, *Haus.* Handb. b. i. s. 307. *Id. Hoff.* b. iv. s. 242. *Id. Kid,* vol. ii. p. 226. *Id. Aikin,* p. 183.

External Characters.

Its colour is intermediate between dark greyish-black and brownish black, which sometimes inclines to velvet-black. It has rarely a temper-steel tarnish.

It occurs massive, and rarely disseminated; also in distinct concretions, which are thick or thin lamellar, either fortification-

fortification-wise bent, or concentrically curved, and sometimes longish granular. It is frequently crystallized; and the primitive figure is an oblique four-sided prism of 120°. The following are some of the secondary forms:

1. Oblique four-sided prism, of which the following varieties occur:
   a. Obtuse lateral edges, flatly, singly, or doubly bevelled.
   b. Obtuse lateral edges truncated.
   c. Obtuse lateral edges, bevelled and truncated, thus forming a reed-like crystal.
   d. Acute lateral edges truncated.
   e. Oblique four-sided prism, acuminated with four planes, which are set on the lateral edges.
   When the two acuminating planes, which are inclined to the acuter lateral edges become larger than the others, there is formed
   f. A rather flat bevelment on the terminal planes; but in this figure, the edges of the bevelment is truncated, and the edges between the bevelling and lateral planes are truncated. If, on the contrary, the bevelling planes that rest on the obtuse lateral edges become large, there is formed
   g. A very flat bevelment on the terminal planes of prism. Sometimes one of the bevelling planes almost disappears, when there is formed a
   h. Prism with oblique terminal planes.
2. Twin-crystal, known by its re-entering angle.

The crystals are middle-sized and large, and occur imbedded, or intersecting one another, but are seldom distinct.

The

The lateral planes are usually longitudinally streaked, and generally splendent.

The cleavage is shining or splendent; the fracture is glistening; the lustre is resinous, inclining to adamantine.

It has always one distinct cleavage, which is parallel with the shorter diagonal, and another less distinct in the direction of the longer diagonal of the prism.

The fracture is coarse and small grained uneven.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It yields a dark reddish-brown coloured streak.

It is harder than apatite, but not so hard as felspar.

It is rather brittle, and easily frangible.

Specific gravity, 7.1, 7.4, *Mohs.*—7.130, *Gellert.*—7.1195, *Brisson.*—7.000, *Leonardi.*—7.3333, *Haüy*—7.006, *Kirwan.*

Chemical Characters.

It decrepitates before the blowpipe, but is infusible without addition. It colours glass of borax reddish, when exposed to the exterior flame of the blowpipe.

Constituent Parts.

Tungstic Acid, -	64.0	67.00
Oxide of Manganese,	22.0	6.25
Oxide of Iron, -	13.5	18.10
Silica, - - -	...	1.30
	99.5	92.75
	D'Elhuyar, Mem. de l'Acad. d. Toulouse, ii.	*Vauquelin*, in Journ. d. Min. N. 19. 18.

Geognostic

Geognostic Situation.

It occurs in primitive rocks, and generally along with tinstone and tungsten; less frequently in veins in greywacke, along with galena or lead-glance, grey copper, sparry iron, and quartz.

Geographic Situation.

It occurs in gneiss in the island of Rona, one of the Hebrides *; at Herland, Pednandre, Huel Fanny, Cliga, and Kit-hill, in Cornwall; in the Hartz, it is met with in veins that traverse greywacke; in primitive rocks at Ehrenfriedersdorf, Altenberg and Geyer, in Saxony; Zinnwald and Schlackenwald in Bohemia; Puy les Mines in France; and at Adonschelon in Siberia, along with beryl.

Observations.

1. It is distinguished from *Tinc-ore*, among other characters, by its streak, which is reddish-brown, whereas that of tin-ore is grey.

2. This mineral was originally mistaken for antimony, which by the alchemists was called the *wolf*; probably because it acted violently upon, and, as it were, devoured the base metals in the process of refining gold; hence arose the term *spuma lupi*; the word *ram*, which signifies spuma, being commonly applied by the Germans to substances of a laminated texture.—*Kid*, vol. ii. p. 227.

GENUS V.

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* MacCulloch.

GENUS V. TANTALUM-ORE.

Tantal-Erz, *Mohs*

THIS Genus contains one species, viz. Prismatic Tantalum-ore. * Yttrotantalite.

1. Prismatic Tantalum-Ore.

Prismatisches Tantal-erz, *Mohs.*

Tantalite, *Karsten & Werner.*

Columbite, *Hatchett.*

Tantalit, *Eckeberg*, Kongl. Vetensk. Acad. Handl. 1802, Q. 1. p. 68.–83.—Tantalite, *Reuss*, b. ii. 4. s. 685.—Columbeisen, *Id.* b. ii. 4. s. 632.—Tantalit, *Leonhard*, Tabel. s. 83.—Tantal oxydé ferro-manganesifère, *Haüy*, Tabl. p. 120.—Tantalit, *Haus.* Handb. b. i. s. 310. *Id. Hoff.* b. iv. s. 191. *Id. Aikin*, p. 142.

External Characters.

Its colours are greyish and brownish black.

It occurs massive, disseminated, and crystallized in oblique four-sided prisms, the dimensions of which are unknown. These prisms are sometimes truncated on two, sometimes on all the lateral edges, and flatly bevelled on the extremities, the bevelling planes resting on the acute lateral edges.

The crystals are small, and appear to occur imbedded.

Externally

Externally and internally it is shining or glistening, and the lustre is resinous, inclining to the semi-metallic adamantine.

The fracture is coarse-grained uneven, or small and imperfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is opaque.

It is as hard as felspar.

The streak is dull and dark brownish-black.

It is brittle.

It is difficultly frangible.

Specific gravity, 6.0, 6.3, *Mohs.*—5.918, *Hatchett.*—7.15 to 7.65, *Wollaston.*—7.953, *Eckeberg.*—7.3, *Klaproth.*—6.464, *Leonhard* and *Vogel.*

Chemical Characters.

Before the blowpipe, without addition, it suffers no other change than a diminution of lustre. It is insoluble in glass of borax.

Constituent Parts.

	Finland.	Finland.	Finland.	N. America or Columbite.
Oxide of Tantalum,	83	85	88	80
Oxide of Iron, -	12	10	10	15
Oxide of Manganese,	8	4	2	5
	103	99	100	100
	Vauquelin, in Haüy, Tabl. p. 308.	*Wollaston*, in Ph. Tr. 1809.	*Klaproth*, Beit. b. v. s. 5.	*Wollaston*, in Ph. Tr. 1809.

Some

Some late analyses of Berzelius shew that it also contains Oxide of Tin.

Geognostic and Geographic Situations.

It occurs disseminated in a coarse red granite, at Brokärns Zinnsgute in the parish of Kemito in Finland; near Bodenmais in Germany; and the specimen examined by Mr Hatchett is said to be from Massachusets Bay in North America.

Observations.

1. This speeies bears a considerable resemblance to several other minerals, particularly to magnetic iron-ore, tin-ore, wolfram, yttrotantalite, and gadolinite. It is distinguished from *Magnetic Iron-ore*, by its not affecting the magnetic needle, brownish-black streak, and its greater specific gravity; from compact *Black Tin-ore*, by its brownish-black powder, and also by the action of the blowpipe, for tinstone, when exposed, on charcoal, to the reducing flame of the blowpipe, is reduced; and from *Wolfram*, by the absence of the cleavage, and the action of the blowpipe, as wolfram, along with glass of borax, when exposed to the exterior flame of the blowpipe, becomes of a reddish colour.

2. The specific gravities vary so much, that it is probable either that some of them are erroneous, or that they characterize different varieties.

* Yttrotantalite.

Yttrotantalite.

Ytter-Tantal, *Karsten*.

Yttertantalit, *Eckeberg*, Kongl. Vetensk. Acad. Handl. 1802, Q. 1.—Yttertantal, *Reuss*, Min. ii. 4. s. 637. *Id. Leonhard*, Tabel. s. 83. *Id. Karsten*, Tabl. s. 74.—Tantal oxydé yttrifère, *Haüy*, Tabl. p. 120.—Yttertantalit, *Haus.* Handb. b. i. s. 312.—Yttrotantalite, *Aikin*, p. 72.

External Characters.

Its colours are iron-black, and yellowish-brown.

It occurs in imbedded angular pieces, in granular distinct concretions, and it is said also crystallized in oblique four-sided prisms, having lateral edges of 95° and 85°, and also in six-sided prisms.

Internally it is shining or glistening, and the lustre resinous, inclining to metallic.

Its cleavage appears to be in the direction of the lateral planes of the oblique four-sided prism.

The fracture is conchoidal.

It is opaque, or translucent on the edges.

It is so hard as to scratch glass.

It yields a grey-coloured streak.

It is easily frangible.

Specific gravity 5.395, 5.882, *Berzelius*.

Chemical Characters.

It decrepitates feebly before the blowpipe, becomes dark-brown, but does not melt.

Constituent

Constituent Parts.

	Black Variety.	Yellow Variety
Oxide of Tantalum,	57.00	60.124
Yttria, -	20.25	29.780
Lime, - -	6.25	0.500
Oxide of Iron, -	3.50	1.155
Oxide of Uranium,	0.50	6.622
Tungstic Acid, -	8.25	with Tin, 1.044
	95.75	99.225

Berzelius in Afhandlingar, t. iv. p. 267.

Geognostic and Geographic Situations.

It occurs along with gadolinite, in a bed of flesh-red felspar, in gneiss at Ytterby near Roslagen in Sweden.

GENUS VI.—URANIUM-ORE.

Uran-Erz, *Mohs.*

THIS Genus contains one Species, viz. Indivisible Uranium-Ore.

1. Indivisible Uranium, or Pitch-Ore.

Untheilbares Uran-Erz, *Mohs.*

Uranpecherz, *Werner.*

Id. Wern. Pabst. b. i. s. 170.—Pech-Blende, *Wid.* s. 987.—Sulphurated Uranite, *Kirw.* vol. ii. p. 305.—Pech-Blende, ou Blende

Blende de Poix, *De Born*, t. ii. p. 159.—Schwarz Uranerz, *Emm.* b. ii. s. 580.—Mine d'Uranit sulphuré, *Lam.* t. i. p. 408. —Uran oxydulé, *Haüy*, t. iv. p. 280.—Le Pecherz, ou L'Urane noir, *Broch.* t. ii. p. 460.—Pecherz, *Reuss*, b. iv. s. 551. *Id. Lud.* b. i. s. 307.—Uranpecherz, *Suck.* 2ter th. s. 466.—Pecherz, *Bert.* s. 511. *Id. Mohs*, b. iii. s. 716.—Uran oxydulé, *Lucas*, p. 176.—Pecherz, *Leonhard*, Tabel. s. 80.—Uran oxydulé, *Brong.* t. ii. p. 102. *Id. Brard*, p. 378.—Pecherz, *Karsten*, Tabel. s. 74.—Uran oxydulé, *Haüy*, Tabl. p. 113.—Pech-Blende, *Kid*, vol. ii. p. 220.—Pech-Uran, *Haus.* Handb. b. i. s. 325.—Uranpecherz, *Hoff.* b. iv. s. 271. —Pitch-Blende, *Aikin*, p. 138.

External Characters.

Its most frequent colour is greyish-black, which sometimes inclines to iron-black, seldomer to brownish and greenish-black.

It generally occurs massive, seldom disseminated, sometimes reniform; also in distinct concretions, which are coarse and small angulo-granular, rarely in others which are reniform curved lamellar, and which are intersected with short wedge-shaped prismatic concretions.

Internally it is shining, inclining to glistening, and the lustre is resinous, inclining to semi-metallic.

The fracture is imperfect and flat conchoidal, which passes into coarse-grained uneven.

The fragments are indeterminate angular, and sharp-edged.

Its hardness is intermediate between that of apatite and felspar.

It is opaque.

In the streak it is black and shining.

It is brittle, and easily frangible.

Specific

Specific gravity, 6.4, 6.6, *Mohs.*—6.5304, *Haüy.*—6.440, *Breithaupt.*

Chemical Characters.

It is completely infusible, without addition, before the blowpipe. With soda or borax it forms a grey, muddy, slaggy-like globule; with phosphoric salts a transparent green bead. It dissolves imperfectly in sulphuric and muriatic acids; but it is nearly completely dissolved in nitric and nitro-muriatic acids; and from this solution, which has a pale orange-yellow colour, the uranium is precipitated brownish-red by prussiate of potash, and yellow by the alkalies.

Constituent Parts.

	Joachimsthal.
Oxide of Uranium, -	86.5
Black Oxide of Iron, -	2.5
Galena or Lead-glance, -	6.0
Silica, - -	5.0

Klaproth, Beit. b. ii. s. 221.

Geognostic Situation.

It occurs principally in primitive rocks, in veins, and most frequently in those which contain ores of silver. Its most frequent accompanying minerals are copper-pyrites, galena or lead-glance, uran-mica, and brown-spar; also red silver, and native silver.

Geographic Situation.

It is found at Tol Carn and Tincroft in Cornwall; in mica-slate at Johanngeorgenstadt, Schneeberg, and Wiesenthal

thal in Germany; in granite at Joachimsthal in Bohemia; and Kongsberg in Norway.

Observations.

It was at first considered as a variety of blende, and named *Pechblende*, and afterwards as an ore of iron, and described under the name *Eisenpecherz*.

2. It is distinguished from *Black-Blende*, by its fracture, streak, and greater specific gravity; from *Wolfram*, by its streak; and from *Pitchy Iron-ore*, by its streak, and greater specific gravity.

GENUS VII. CERIUM-ORE.

Cerer-erz, *Mohs.*

THIS Genus contains two Species, viz. 1. Prismatic Cerium-Ore. 2. Indivisible Cerium-Ore.

1. Prismatic Cerium-Ore, or Allanite.

Allanite, Edinburgh Phil. Trans. vol. vi. p. 371.—Cerium oxydé silicifere noire, *Lucas*, t. ii. p. 498.—Cerium allanite, *Delam.*

External Characters.

Its colour is brownish-black.

It occurs massive, disseminated, and crystallized in the following figures:

1. Oblique four-sided prism, with lateral edges of 117° and 63°.
2. Six-sided prism, acuminated with four planes, set on the lateral planes.

Externally it is dull.

Internally it is shining, and resino-metallic.

The fracture is small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is opaque.

It affords a greenish-grey coloured streak.

It is brittle, and easily frangible.

Specific gravity 3.523 to 4.001, *Thomson*.

Chemical Characters.

Before the blowpipe it froths, and melts imperfectly, into a black scoria. Gelatinates in nitric acid *. In a strong heat it loses 3.98 *per cent.* of its weight.

Constituent Parts.

Oxide of Cerium, - -	33.9
Oxide of Iron, -	25.4
Silica, - -	35.4
Lime, - -	9.2
Alumina, -	4.1
Moisture, - -	4.0
	112.0

Thomson, in Edin. Phil. Trans. vol. vi. p. 385.

Geognostic

* This is doubted by Haüy.

Geognostic and Geographic Situations.

It occurs in a granite rock in West Greenland, where it was first discovered by Professor Giesecké of Dublin,—an intelligent naturalist, and a gentleman of great worth, who, with a rare zeal and intrepidity, and in defiance of the horrors and miseries of that forlorn region, courageously devoted many years of his life to the investigation of its natural history. It has been lately detected at Bastnaes in Sweden.

Observations.

It was first described and analysed by Dr Thomson, who named it Allanite, in honour of Thomas Allan, Esq. who was first aware of its being a particular and undescribed mineral substance.

2. Indivisible Cerium-Ore, or Cerite.

Untheilbares Cerer-erz, *Mohs.*

Bastnäs Tungsten, *Cronstedt,* (first description), in the Abh. d. Schwed. Akad. 1751, s. 235.—Cerit, *Hisinger & Berzelius,* S. Cerium en ny metall, funnen i Bastnäs Tungsten fran Riddarhyttan i Westmannland, Af. Hisinger & Berzelius, Stockholm, 1804, 8.—Cerit, *Hisinger & Berzelius,* in Afh. i Fys. Kem. och. Min. 1. 58. *Id. Leonhard,* Tabel. s. 83. *Id. Karsten,* Tabel. s. 74.—Cerium oxydé silicifere, *Hauy,* Tabl. p. 120.—Cerinstein, *Hoff.* b. iv. s. 286.—Cerite, *Aikin,* p. 141.

External Characters.

Its colour is intermediate between crimson-red, clove-

 brown,

brown, and reddish-brown; also dark or pale flesh-red, and very rarely inclines to yellow.

It occurs massive, and disseminated.

Internally it is glimmering and resinous.

The fracture is fine splintery.

The fragments are indeterminate angular, and not particularly sharp-edged.

It is opaque.

It has nearly the same degree of hardness as prismatic cerium-ore.

Its streak is greyish-white.

Specific gravity, 4.6, 4.5, *Mohs.*—4.988, *Cronstedt.*—4.660, *Klaproth.*—4.619 and 4.489, *Hisinger* and *Berzelius.*

Chemical Characters.

It is infusible before the blowpipe; but when pulverized and heated, its colour changes from grey to yellow.

Constituent Parts.

Oxide of Cerium,	54.50	67
Silica, -	34.50	17
Oxide of Iron,	3.50	2
Lime, -	1.25	2
Water, -	5.00	and Carbonic Acid, 12
	98.75	100
	Klaproth, Beit. b. iv. s. 147.	*Vauquelin*, in Annal. d. Mus. t. v. p. 412.

Geognostic and Geographic Situations.

It occurs in a bed of copper-pyrites, along with bismuth-glance, or sulphuretted bismuth, molybdena, wolfram? hornblende,

hornblende, actynolite, and mica. The bed is situated in gneiss near Ridderhytta in Westmannland in Sweden.

Observations.

The peculiar metal which characterizes this ore, was first detected by Hisinger and Berzelius, who bestowed on it the name *Cerium*, from the planet Ceres, discovered by Piazzi.

GENUS VIII. CHROME-ORE.

Chrom-erz, *Mohs.*

THIS Genus contains one species, viz. Prismatic Chrome-Ore.

1. Prismatic Chrome-Ore.

Prismatisches Chrom-erz, *Mohs.*

Chromeisenstein, *Hausmann.*

Eisenchrom, *Reuss*, Min. b. iv. s. 625.—Fer chromaté, *Brong.* t. ii. p. 181. *Id. Brard*, p. 33.—Eisenchrom, *Karsten*, Tabel. s. 74.—Fer chromaté, *Haüy*, Tabl. p. 99.—Chromeisenstein, *Haus.* Handb. b. i. s. 252. *Id. Hoff.* b. iii. s. 226.—Chromate of Iron, *Aikin*, p. 106.

External Characters.

Its colour is intermediate between steel-grey and iron-black, and sometimes passes into brownish-black.

It

It occurs massive, disseminated, and in granular distinct concretions; also crystallized in oblique four-sided prisms, acuminated with four planes.

Internally it is shining or glistening, and the lustre is imperfect metallic.

It has an imperfect prismatic cleavage.

The fracture is small and fine-grained uneven, sometimes passing into small and imperfect conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is opaque.

Its hardness is intermediate between that of apatite and felspar.

The colour of the streak is dark brown.

Specific gravity 4.4, 4.5, *Mohs.*

Physical Characters.

Some varieties are magnetical, others are not.

Chemical Characters.

It is infusible before the blowpipe. Melted with borax, it forms a beautiful green-coloured mass, very different from the dark green-coloured glass formed when borax and magnetic iron-ore are melted.

Constituent Parts.

	France.	Siberia.
Oxide of Iron,	34.7	34
Oxide of Chrome,	43.0	53
Alumina, -	20.3	11
Silica, -	2.0	1
Oxide of Manganese, -		1
	100.00	100
	Hauy, Traité, t. iv. p. 130.	*Laugier*, Ann. du Mus. t. iv. p. 325.

	Stiria.
Oxide of Iron,	33.00
Oxide of Chrome,	55.50
Alumina, -	6.00
Silica, -	2.00
Loss by heating,	2.00
	98.50
	Klaproth, Beit. b. iv. s. 132.

Geognostic

Geognostic Situation.

It occurs in beds, veins, or imbedded in primitive serpentine; in a variety of talc-slate, to which it has given a beautiful colour, intermediate between cochineal-red and peach-blossom-red; also in beds between clay-porphyry and wacke.

Geographic Situation.

Europe.—It occurs in serpentine in the islands of Unst and Fetlar in Shetland; and also in the serpentine of Portsoy in Banffshire. On the Continent, it occurs in serpentine near to Gassin, in the department of Var, and in serpentine in the vicinity of Nantes; at Krieglach in Stiria, it is imbedded in talc-slate, to which it has communicated a beautiful red colour; Bohemia; Silberberg in Silesia; and Traversella in Piedmont.

Asia.—It is said to occur in beds between clay-porphyry and wacke in the Uralian Mountains.

America.—It occurs in considerable quantity in serpentine in the Bare Hills, near Baltimore; at Chesnut-hill in Pennsylvania; at Hoboken in New Jersey; and in the Milford Hills, near Newhaven in Connecticut *.

Uses.

When the chromic acid is combined with lead, it forms an uncommonly beautiful yellow pigment. In America, where the chrome ore occurs in considerable abundance, the chromic acid is extracted from it, and combined with lead, and forms the yellow pigment named *Chromic yellow*, which is now become an article of trade.

Observations.

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* Hayden, in Bruce's American Min. Journal, p. 243,—248; and Cleaveland's Mineralogy, p. 507, 508.

Observations.

It is distinguished from *Magnetic Iron-ore* by its brown streak.

Genus IX.—IRON-ORE.

Eisen-erz, *Mohs.*

This Genus contains three Species, viz. 1. Octahedral Iron-Ore, 2. Rhomboidal Iron-Ore, 3. Prismatic Iron-Ore.

1. Octahedral Iron-Ore.

Octaedrisches Eisen-erz, *Mohs.*

This species is divided into two subspecies, viz. Common Magnetic Iron-Ore, and Granular Magnetic Iron-Ore. * Earthy Magnetic Iron-Ore.

First Subspecies.

Common Magnetic Iron-Ore.

Gemeiner Magneteisenstein, *Werner.*

Ferrum mineralisatum crystallisatum, et Ferrum mineralisatum, minera ferrum trahente et polos mundi ostendente, *Wall.* t. ii. p. 234.–235.—Æthiops martial natif, *Romé de Lisle,* t. iii. p. 176.—Magnetischer Eisenstein, *Werner,* Pabst. b. i. s. 144. *Id. Wid.* s. 787.—Common Magnetic Ironstone, *Kirw.* vol. ii. p. 158.—Gemeiner magnetischer Eisenstein, *Emm.* b. ii. s. 278. —Fer oxydulé, *Haüy,* t. iv. p. 10–38.—Le Fer magnetique commun,

commun, *Broch.* t. ii. p. 235.—Gemeiner Magneteisenstein, *Reuss,* b. iv. s. 38. *Id. Lud.* b. i. s. 240. *Id. Suck.* 2ter th. s. 247. *Id. Bert.* s. 401. *Id. Mohs,* b. iii. s. 355. *Id. Hab.* s. 113.—Fer oxydulé, *Lucas,* p. 136.—Gemeiner Magneteisenstein, *Leonhard,* Tabel. s. 63.—Fer oxydulé, *Brong.* t. ii. p. 156. *Id. Brard,* p. 310.—Gemeiner & Blättricher Magneteisenstein, *Karsten,* Tabel. s. 64.—Blättricher, körniger & dichter Magneteisenstein, *Haus.* s. 105.—Magnetic Iron-ore, *Kid,* vol. ii. p. 165.—Fer oxydulé, *Haüy,* Tabl. p. 93.—Gemeiner Magneteisenstein, *Hoff.* b. iii. s. 217.—Magnetic Iron-ore, *Aikin,* p. 97.

External Characters.

Its colour is iron-black, and very seldom with a temper-steel tarnish.

It occurs massive, disseminated, and in distinct concretions, which are large, small, and fine granular. Also crystallized in the following figures:

1. Octahedron *, fig. 193. Pl. 10. which sometimes ends in a line. This is the primitive figure.
   - *a.* Truncated on the edges †, fig. 194. Pl. 10.
   - *b.* Bevelled on the edges, fig. 195. Pl. 10.
   - *c.* Truncated on the angles.
   - *d.* Cuneiform ‡.
   - *e.* Acuminated on all the angles with four planes.
2. Garnet or rhomboidal dodecahedron ||, fig. 196. Pl. 10.

3. Rectangular

* Fer oxydulé primitif, Haüy.

† Fer oxydulé emarginé, Haüy.

‡ Fer oxydulé cuneiforme, Haüy.

|| Fer oxydulé dodecaedre, Haüy.

3. Rectangular four-sided prism, acuminated with four planes, which are set on the lateral edges, fig. 197. Pl. 10.
4. Cube, either perfect, or more or less deeply truncated on the angles, fig. 198. Pl. 10.
5. Tetrahedron, in which all the angles are truncated.
6. Equiangular six-sided table, in which the terminal planes are set on alternately oblique.
7. Twin-crystal, with three re-entering angles, formed by the meeting of two segments of the tetrahedron, or of two six-sided tables.

The planes of the rhomboidal dodecahedron are streaked in the direction of the larger diagonal of the rhomb; the planes of the four-sided prism are transversely streaked, and those of the octahedron are smooth.

The crystals are usually imbedded, or aggregated on one another.

The crystals are small and very small, seldom middle-sized.

Externally it is shining, glistening, or splendent.

Internally it is intermediate between shining and glistening, and the lustre is metallic.

It has a fourfold cleavage, the folia parallel with the planes of the octahedron.

The fracture is small and coarse-grained uneven, which sometimes approaches to even, seldom to imperfect and small conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

The colour of the streak is black.

Some varieties are harder than apatite, others harder than felspar, but none so hard as quartz.

It

It is brittle, and sometimes difficultly, sometimes easily frangible.

Specific gravity, 4.8, 5.2, *Mohs.*—From Dannemora, 4.9364, *La Metherie.*—4.760, *Klaproth.*—4.820, *Karsten.*

Physical Characters.

It is highly magnetic, with polarity.

Chemical Characters.

Before the blowpipe it becomes brown, and does not melt: it communicates to glass of borax a dark-green colour.

Constituent Parts.

Peroxide of Iron,	-	69
Protoxide of Iron,	-	31
		100 *Berzelius.*

Dr Thomson analysed a specimen of this ore from Greenland, and which he found to contain, besides the Iron, a small portion of Titanium.—Wern. Memoirs, vol. ii. part i. p. 55.

Geognostic Situation.

It occurs principally in beds, often of great magnitude, in primitive rocks, as gneiss, mica-slate, chlorite-slate, clay-slate, and greenstone, associated with hornblende, augite, actynolite, asbestus, epidote, garnet, felspar, calcareous-spar, fluor-spar, quartz, iron-pyrites, copper-pyrites, magnetic pyrites, arsenical pyrites, blende, galena or lead-glance, and other ores and minerals: also disseminated in granite, chlorite-slate, serpentine, gabbro, &c.; less frequently in beds and nests in transition rocks, as in transition porphyry.

Geographic

Geographic Situation.

Europe.—It occurs in serpentine, in Unst, one of the Shetland Islands; St Just in Cornwall; and Tavistock in Devonshire. In the iron-mines of Arendal in Norway, it occurs in beds in gneiss: these beds are short, but vary in thickness from four to sixty feet; they are frequently intermixed with the gneiss at their line of junction with it; cotemporaneous wedges of the gneiss also occur dispersed through the iron-ore, and sometimes an uninterrupted transition is to be observed from the iron-ore beds into the gneiss in which they are contained. In these interesting repositories, the iron-ore is associated with a great variety of different minerals: of these the most frequent are, granular garnet, augite, hornblende, epidote or pistacite, calcareous-spar, and the three constituents of gneiss. The garnet and augite are the most abundant, are generally in a granular form, and so intimately intermixed with the iron-ore, that an inattentive observer might confound them together. The minerals of less frequent occurrence in these beds, are the following: sphene, the subspecies of garnet named colophonite, apatite, scapolite, sahlite, actynolite, glassy tremolite, chlorite, common shorl, zeolite, iron-pyrites; and still rarer minerals are, prehnite, analcime, rutile, sparry iron, molybdena, copper-pyrites, blende, blue copper, copper-green, and graphite. These minerals are either intermixed with the ironstone in an irregular manner, or they are disposed in cotemporaneous veins included in it, or that shoot from the mass of the bed into the bounding strata of gneiss, just as is the case with cotemporaneous veins of granite shooting from massive granite into the adjacent strata. The remarkable hill named Taberg,

Taberg, in Smoland in Sweden, is a great mass of primitive greenstone, richly impregnated with magnetic iron-ore, and resting on gneiss *; and in the island of Utö, also in Sweden, there are extensive mines of magnetic iron-ore, in which the ironstone occurs as a wedge-shaped bed in gneiss, about 120 feet thick, and nearly half a mile long; but the most considerable of the Swedish iron-mines are those of Danemora, in which the magnetic iron-ore occurs as a bed several hundred feet thick, in gneiss, and is associated with tremolite, chlorite, asbestus, actynolite, and, what is worthy of particular notice, *mineral pitch.* There are also great beds of magnetic ironstone at Gellivara, in Luleo Lappmark, Luossavara, Kensivara, and Junossuwando. At Breitenbrunn, in the Saxon Erzgebirge, it is associated with common garnet, common hornblende, amianthus, actynolite, fluor-spar, iron-pyrites, magnetic pyrites, arsenical pyrites, blende, and tin-ore; at Geier, with magnetic pyrites, galena or lead-glance, and actynolite; at Kupferberg in Silesia, along with copper and iron pyrites; at Presnitz, also in Silesia, in beds in gneiss; in Bavaria; Franconia; Lusatia; Hartz; and Thuringia; at Cogne in Piedmont, there is a bed of this ore, about seventy-five feet thick, which is inclosed in a great bed of serpentine, subordinate to mica-slate; it is also found in Corsica, Sardinia, Switzerland, Spain, France, Hungary, and Transylvania.

Asia.—It is is found in the Mysore country in Hindostan †; Nertschinsk, Parmien, and other places in Siberia; Siam;

* Vid. Thomson's Travels in Sweden, and Hausmann's Travels in the same country, for descriptions of the Taberg.

† Dr Ainslie's Materia Medica of Hindoostan, and Artizans and Agriculturists Nomenclature, p. 55. 4to, printed at Madras in 1813.

Siam; China; the Philippine Islands; and New Holland.

North America.—It occurs in West Greenland; in New Spain; immense beds of it extend, with little interruption, from Canada to the neighbourhood of New York. Colonel Gibbs describes a bed of this ore as occurring at the Franconia Iron-works in New Hampshire *.

South America.—It occurs in Chili.

Uses.

When pure, it affords excellent bar-iron, but indifferent cast-iron; and as it is easily fusible, it requires but little flux. When it happens to have intermixed copper or iron pyrites, it affords a red-shot iron. Careful roasting of ore thus mixed, diminishes the bad effects of the sulphur, which is evidently the cause of the deterioration of the iron. In Sweden, particularly at Dannemora, the ore is quite pure, and affords excellent bar-iron, which is imported into Great Britain, for the purpose of steel-making.

Second Subspecies.

Granular Magnetic Iron-Ore, or Iron-Sand.

Eisensand, *Werner.*

Id. Werner, Pabst. b. i. s. 147. *Id. Wid.* s. 790.—Magnetic Sand, *Kirw.* vol. ii. p. 161.—Eisensand, *Emm.* b. ii. s. 284.—Le Fer magnetique sablonneux, *Broch.* t. ii. p. 241.—Sandiger Magneteisenstein, *Reuss,* b. iv. s. 48.—Eisensand, *Lud.*

* Bruce's Mineralogical Journal, p. 5. and 6.

Lud. b. i. s. 241. *Id. Suck.* 2ter th. s. 252. *Id. Bert.* s. 402. *Id. Mohs,* b. iii. s. 363.—Magnetischer Eisensand, *Hab.* s. 144. —Sandiger Magneteisenstein, *Leonhard,* Tabel. s. 64.—Fer oxydulé sablonneux, *Brong.* t. ii. p. 157.—Fer oxydulé arenacé, *Brard,* p. 311.—Sandiger Magneteisenstein, *Karsten,* Tabel. s. 64.—Körniger Magneteisenstein, *Haus.* s. 105.—Fer oxydulé titanifere, *Haüy,* Tabl. p. 94.—Magnetischer Eisensand, *Hoff.* b. iii. s. 223.—Sandy Magnetic Iron-ore, *Aikin,* p. 98.

External Characters.

Its colour is very dark iron-black.

It occurs in grains, which are sometimes angular, sometimes roundish; and also in octahedral crystals.

The grains and crystals are small and very small.

The grains have a feeble glimmering, and rough surface.

Internally it is intermediate between shining and splendent, and the lustre is imperfect metallic.

The fracture is perfect and small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is equally hard with common magnetic iron-ore.

It is brittle, and easily frangible.

Its streak is black.

Specific gravity, 4.600, *Kirwan.*—4.76, *Thomson.*—4.890, *Cordier.*

Physical Characters.

It is magnetical, with polarity.

Constituent Parts.

	Niedermenich.	Teneriffe.	Puy.	Shore of the Baltic.	River Dee, Aberdeenshire
Oxide of Iron,	79.0	79.2	82.0	85.50	85.3
Oxide of Titanium,	15.9	14.8	12.6	14.00	9.5
Oxide of Chrome,	a trace.	a trace.	...	...	...
Oxide of Manganese,	2.6	1.6	4.5	0.50	...
Arsenic, -	...	...	...	...	1.0
Silica and Alumina,	1.0	0.8	0.6	...	1.5
	98.5	96.4	99.7	100.0	97.3

Cordier, Journal des Mines, N. 124. p. 249. *Klaproth*, Beit. b. v. s. 210. *Thomson*, Tr. R. Soc. Edin. May 1807.

Geognostic Situation.

It occurs imbedded in basalt, clinkstone, and wacke; in lavas of different kinds; loose in the beds of rivers, and in the sands of coasts and plains.

Geographic Situation.

Europe.—Imbedded in secondary or flœtz-trap rocks in Fifeshire, and in the Island of Skye; in the river Dee in Aberdeenshire, in a sand composed of quartz, felspar, and mica; and also in Argyleshire; at Hustanton, Norfolk, and Arklow, near Wicklow, with native gold. On the Continent, it is met with in Norway; in flœtz-trap rocks at Hohenstein; and in loose sand with hyacinth, iserine, nigrine, hornblende, and augite, in the province of Meissen in Saxony; in sand on the banks of the Elbe, at Schandau, near Pirna; and at Sebnitz, in the same district, along with small grains of hyacinth, and nigrine; in the clinkstone-porphyry of the Milleschau, in Bohemia; and at Treblitz and Podsedlitz, also in Bohemia, intermixed with rolled pieces of basalt,

pyrope,

pyrope, sapphire, and hyacinth; at Greifeswald, on the shore of the Baltic; at Puzzoli, near Naples, in the sand of the shore, along with pieces of pumice, lava, hornblende, and oliven; also in the Island of Ischia; at Messina in Sicily; in the Island of Milo in the Archipelago; in the Tyrol; France; Piedmont; and Hungary.

Asia.—On the shores of the Lake Baikal in Siberia.

America.—In the United States; in the Islands of St Domingo and Guadaloupe; West Greenland; Virginia; and Cayenne.

Uses.

It is, although rarely, smelted as an ore of iron. In the Tyrol, near Naples, and in Virginia, it is smelted in considerable quantity; and, owing to its purity, affords most excellent bar-iron.

* Earthy Magnetic Iron-ore.

Ochriger Magneteisenstein, *Hausmann.*

Eisenschwärze, *Schumacher,* Verzeichniss der Dän. Nord. Mineralien, s. 135. *Id. Reuss,* b. iv. s. 53.—Eisenmulm, *Leonhard,* Tabel. s. 69.—Fer oxydulé fuligineux, *Haüy,* Tabl. p. 94.—Erdiger Magneteisenstein, *Haus.* Handbuch. b. i. s. 249.

External Characters.

Its colour is bluish-black.

It occurs in blunt-edged rolled pieces, in which the surface is sometimes vesicular.

Internally it is dull, or feebly glimmering on spots.

The fracture is fine-grained uneven, passing into earthy.

It is opaque.
It is soft.
It yields a black shining streak.
It soils.
It is sectile, and easily frangible.
It emits a faint clayey smell when breathed on.
Specific gravity 2.200, *Schumacher*.

Geognostic and Geographic Situations.

It occurs in the iron-mines of Arendal, and in the mine of Eiserfeld in Siegen. It appears to be common magnetic iron-ore in a state of decomposition.

Observations on the Species.

1. Common and Granular Magnetic Iron-ores are distinguished from *Specular Iron-ore*, with which they are often confounded, by the colour of the streak, which is black, whereas that of specular iron-ore is cherry-red; by being powerfully magnetic, whereas specular iron-ore is scarcely affected by the magnet; and the crystallizations of magnetic ironstone are different from those of specular iron-ore.

2. Werner was the first who observed that this species of ironstone is not magnetic when at a depth in the earth, but that it acquires this property after exposure to the influence of the atmosphere.

3. The *Titaneisen* of Reuss and others, appears to be but a variety of common magnetic iron-ore; and Hausmann says, that Karsten's *fibrous magnetic iron-ore* is asbestous actynolite intimately intermixed with granular magnetic iron-ore, and is therefore not a distinct subspecies.

2. Rhomboidal

2. Rhomboidal Iron-Ore.

Rhomboedrisches Eisen-erz, *Mohs.*

This species is divided into three subspecies, viz. 1. Specular Iron-ore or Iron-glance, 2. Red Iron-ore, 3. Clay Iron-ore.

First Subspecies.

Specular Iron-Ore.

This Subspecies is divided into two kinds, viz. Common Specular Iron-ore, and Micaceous Specular Iron-ore.

First Kind.

Common Specular Iron-Ore.

Gemeiner Eisenglanz, *Werner.*

Minera Ferri grisea, *Wall.* t. ii. p. 239.—Minera Ferri cœrulescens, *Ibid.* p. 241.—Mine de Fer grise ou speculaire, *Romé de Lisle*, t. iii. p. 186.—Fer speculaire, *De Born*, t. ii. p. 265.——Gemeiner Eisenglanz, *Wern.* Pabst. b. i. s. 147. *Id. Wid.* s. 802.—Specular Iron-ore, *Kirw.* vol. ii. p. 162.—Gemeiner Eisenglanz, *Emm.* b. ii. s. 301.—Fer speculaire, *Lam.* t. i. p. 220. to 225.—Fer oligiste, *Haüy*, t. iv. p. 38.–56.—Le Fer speculaire commun, *Broch.* t. ii. p. 242.—Gemeiner Eisenglanz, *Reuss*, b. iv. s. 61. *Id. Lud.* b. i. s. 242. *Id. Suck.* 2ter th. s. 257.. *Id. Bert.* s. 403. *Id. Mohs*, b. iii. s. 367.—*Id. Hab.* s. 115. *Id. Leonhard*, Tabel. s. 64.—Fer oligiste compacte. *Brong.* t. ii. p. 160.—Gemeiner, körniger, & schiefriger Eisenglanz. *Karsten*, Tabel. s. 64.—Dichter, körniger, blättriger

blättriger Blutstein, *Haus.* s. 105, 106.—Specular Iron-ore, *Kid,* vol. ii. p. 168.—Fer oligiste, *Haüy,* Tabl. p. 94.—Gemeiner Eisenglanz, *Hoff.* b. iii. s. 228.—Red Iron-ore, *Aikin,* p. 99.

External Characters.

Its most common colour is dark steel-grey, which frequently borders on iron-black, and sometimes inclines to brownish-red. It occurs very frequently tarnished on the external surface, or on that of the distinct concretions. The tarnish is either that of tempered-steel, or is pavonine, columbine, or iridescent.

It occurs massive, and disseminated; also in distinct concretions, which are large, coarse and small granular, prismatic, and thin and curved lamellar; and frequently crystallized.

Its primitive form is a rhomboid, or double three-sided pyramid, in which the angles are 87° 9′ and 92° 51′.

The following are some of the secondary figures:

1. *a.* The primitive form bevelled on the common base. *b.* Truncated on the apices. *c.* Acuminated with three planes, which are set on the lateral planes. *d.* Acuminated with three planes, which are set on the lateral edges. Frequently several of these varieties occur in the same crystal.
2. Flat rhomboid, or double three-sided pyramid, in which the angles are 144° and 36′. Sometimes the lateral edges and apices are rounded off, or they are truncated. In other varieties, the angles on the common base are truncated. When the rounding of the edges and apices increases very much, a spherical lens is formed, in which the planes are very much streaked.

3. Equiangular

3. Equiangular six-sided table, in which the terminal planes are sometimes bevelled, and sometimes the edges of the bevelment are truncated.
4. Low equiangular six-sided prism, in which the terminal edges are obliquely truncated.
5. Very acute double six-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other, and the apices of the pyramids more or less deeply truncated. Sometimes the alternate lateral edges are truncated, and occasionally the angles on the common base.

The crystals are middle-sized and small, and generally grouped in druses. The six-sided tables are sometimes singly superimposed.

The planes of the crystals are generally smooth; those of the primitive form are streaked in the direction of the longer diagonal.

Externally it alternates from splendent to glistening, but is most commonly splendent, and the lustre is metallic.

Internally it is generally glistening, but sometimes passes into shining and splendent, and the lustre is metallic.

It has a distinct threefold cleavage, the folia in the direction of the planes of the primitive rhomboid; also a very distinct cleavage in the direction of the lateral planes of the six-sided table. The cleavages are triply streaked.

The fracture is small and imperfect conchoidal, and coarse and small grained uneven.

The fragments are generally indeterminate angular, and rather sharp-edged, and sometimes rhomboidal.

It affords a cherry-red streak.

Its hardness is intermediate between that of felspar and quartz.

It

It is brittle, and rather difficultly frangible.

Specific gravity, 4.939, 5.218, *Brisson.*—5.139, *Kirwan.* —5.180–5.246, *Breithaupt.*

Physical Characters.

When pulverised, it is magnetic in a slight degree, but it does not, like magnetic ironstone, attract filings of iron.

Chemical Characters.

Before the blowpipe, without addition, it is infusible; melted with borax, it gives a muddy yellow-coloured scoria.

Constituent Parts.

From Zocka.		From Grengesberget.	
Oxide of Iron,	88.00	Reddish-brown Oxide of iron, -	94.38
Oxide of Manganese,	0.75	Phosphate of Lime,	2.75
Iron-pyrites, -	8.25	Magnesia, -	0.16
Silica, -	0.50	Mineral Oil ?	1.25
Magnesia, -	0.12	Loss by heating,	0.50
Loss, - -	2.53		
			98.94

Brocchi, Trattato Mineralogico e Chemico sulle Miniere de Turro del Departemento del Mella, vol. ii. p. 42.

Hisinger, Afhandlingar, iii. p. 32, 33.

Geognostic Situation.

It generally occurs in beds, which are often very thick, in primitive mountains. In these beds, it is associated with magnetic

magnetic iron-ore, red iron-ore, iron-pyrites, copper-pyrites, arsenical pyrites, quartz, hornstone, and calcareous-spar. It also occurs in veins that traverse granite, gneiss, mica-slate, clay-slate, and grey-wacke, in which it is accompanied with red and brown iron-ores, iron-pyrites, tin-ore, quartz, lithomarge, brown-spar, fluor-spar, felspar, epidote or pistacite, and asbestus. It rarely occurs in vesicular cavities and fissures of volcanic rocks, and in veins in some sandstone and flœtz-trap rocks.

Geographic Situation.

Europe.—It occurs, along with red and brown iron-ore, at Cumberhead in Lanarkshire; in the iron-mines of Norberg in Westmannland; at Wika in Dalecarlia; Langbanshytta in Wärmeland; at Bitsberg; also in the mountains of Haukiwara, near Luossawara in Lapland; in Norway; and the government of Olnetz in Russia. It is found in many of the iron-mines in the Saxon Erzgebirge, and generally associated with red iron-ore, as is also the case in the iron-mines of Franconia, Bavaria, and Hessia. In Bohemia, it occurs in beds in mica-slate; in Silesia, in mica-slate, subordinate to gneiss, which rests immediately on granite, and also in the hornblende formation which rests on gneiss. The mountains of Switzerland do not afford much specular iron-ore; small portions of it are met with in St Gothard, and in mica-slate at the foot of the Great St Bernard. Although it is not a frequent ore in France, it is mentioned as occurring along with red iron-ore at Framont; in small quantity at Markirch in Alsace; and in Dauphiny; and in the Puy de Dôme, and Volvic. In the Island of Corsica, it is associated with brown iron-ore; and in the Island of Stromboli, in lava; but of all the

the islands in the Mediterranean, Elba is that which affords common specular iron-ore in the greatest abundance. There, it is associated with brown iron-ore, and quartz; and the mines, which are of great extent, have been worked for upwards of 3000 years. It is also one of the mineral productions of Salzburg, and Hungary.

Asia.—It occurs in the mines of Beresowskoi, in the Uralian Mountains; and also in the Mysore country in Hindostan *.

America.—In the United States; and in the mines of Sombrerete in Mexico; and in Chili in South America.

Uses.

When it occurs in quantity, it is smelted as an ore of iron. It affords an excellent malleable iron, which, however, is harder than that obtained from magnetic iron-ore. It affords also cast-iron which is of good quality, but not so much valued as that obtained from other ores of iron.

Observations.

1. It passes, on the one hand, into Common Magnetic Iron-ore; and on the other into Red Iron-Ore.

2. It is easily distinguished from *Magnetic Iron-Ore* by its streak; magnetic iron-ore yielding a black, whilst Common Specular Iron-ore affords a cherry-red streak.

Second

* Ainslie's Materia Medica, p. 55.

Second Kind.

Micaceous Specular Iron-Ore.

Eisenglimmer, *Werner*.

Mica ferrea, *Wall.* t. ii. p. 242.—Mine de Fer micacée grise, *Romé de Lisle*, t. iii. p. 205.—Eisenglimmer, *Werner*, Pabst. b. i. s. 152. *Id. Wid.* s. 805.—Micaceous Iron-ore, *Kirw.* vol. ii. p. 184.—Mine de Fer micacée grise, *Lam.* t. i. p. 241. —Eisenglimmer, *Emm.* b. ii. s. 306.—Fer oligiste ecailleux, *Haüy*, t. iv. p. 45.—Le Fer micacé, *Broch.* t. ii. p. 247.—Schuppiger Eisenglanz, *Reuss*, b. iv. s. 71. Eisenglimmer, *Lud.* b. i. s. 243. *Id. Suck.* 2ter th. s. 262. *Id. Bert.* s. 405. *Id. Mohs*, b. iii. s. 378.—Schuppiger Eisenglanz, *Leonhard*, Tabel. s. 64.—Fer oligiste ecailleux, *Brong.* t. ii. p. 162.—Schuppiger Eisenglanz, *Karsten*, Tabel. s. 64.—Schuppiger Blutstein, *Haus.* s. 106.—Fer oligiste ecailleux, *Haüy*, Tabl. p. 95.—Eisenglimmer, *Hoff.* b. iii. s. 236.—Micaceous Red Iron-ore, *Aikin*, p. 100.

External Characters.

Its colour is iron-black, of different degrees of intensity; thin plates or folia, when held between the eye and the light, appear blood-red.

It occurs most commonly massive and disseminated; frequently in coarse, small and fine granular concretions; also crystallized in small thin six-sided tables, in which the terminal planes are set alternately oblique and straight on the lateral planes.

These tables sometimes intersect each other, so as to form cells.

The

The surface of the crystals is smooth and splendent.

Internally it is splendent, which in some varieties passes into shining, and the lustre is metallic.

The cleavage is perfect and curved foliated, with a single cleavage.

The fragments are sometimes indeterminate angular, sometimes tabular.

It is slightly translucent on the edges; but translucent in thin plates.

Its streak is cherry-red.

It is nearly as hard as common specular iron-ore.

It is brittle, and uncommonly easily frangible.

Specific gravity 5.070, *Kirwan*.

Physical Characters.

It slightly affects the magnet.

Constituent Parts.

According to Bucholz, this subspecies consists entirely of Peroxide of Iron.—*Gehlen's* Journal, 2d series, b. iii. s. 104.

Geognostic Situation.

It generally occurs in veins or in beds in mica-slate, and clay-slate; and in these repositories it is usually associated with red and brown iron-ores, and iron-pyrites, and sometimes with copper-pyrites, sparry iron, calcareous-spar, fluor-spar, and quartz.

Geographic Situation.

Europe.—It occurs in veins in primitive rocks near Dunkeld, and in Benmore in Perthshire; also in Fitful-head,

head, and other places in Mainland, the largest of the Shetland Islands. In England, it is met with at Tavistock in Devonshire; Eskdalde in Cumberland; near Bristol; and in Caernarvonshire. The iron-mines in Norway and Sweden, afford small quantities of this ore; and it is also met with in the iron-mines of Olnetz in Russia, and in those in Saxony, Bohemia, Lusatia, Silesia, Franconia, Suabia, Bavaria, France, Island of Elba, and Hungary.

Asia.—In the mines of Catharinenburg in Siberia.

America.—Chili.

Uses.

It melts better than common specular iron-ore, but requires a greater addition of limestone. The iron which it affords is sometimes cold-short, but is well fitted for cast-ware.

Observations.

1. It is characterized by its high degree of lustre, openness of its cleavage, and easy frangibility; and these characters distinguish it from *Common Specular Iron-ore.* Its inflexibility, colour, and considerable hardness, distinguish it from *Black Mica;* its greater weight, and its not soiling, distinguish it from *Graphite;* and its greater hardness, and inferior weight distinguish it from *Brittle Silver.*

2. It passes into Red Scaly Iron-ore.

3. It affords from 70 to 80 *per cent.* of iron.

4. Common specular iron-ore occurs usually with quartz; whereas magnetic iron-ore is frequently accompanied with limestone.

5. It is the *Eisenmann* of older mineralogists.

Second

Second Subspecies.

Red Iron-Ore.

Rotheisenstein, *Werner.*

This species is divided into four kinds, viz. Scaly Red Iron-ore, Ochry Red Iron-ore, Compact Red Iron-ore, and Fibrous Red Iron-ore or Red Hematite.

First Kind.

Scaly Red Iron-ore or Red Iron-froth.

Rother Eisenrahm, *Werner.*

Hæmatites micaceus, *Wall.* t. ii. p. 248.—Rother Eisenrahm, *Werner,* Pabst. b. i. s. 153. *Id. Wid.* s. 807.—Red scaly Iron-ore, *Kirw.* vol. ii. p. 172.—Rother Eisenrahm, *Emm.* b. ii. s. 308.—Fer oxidé rouge luisant, *Haüy,* t. iv. p. 106.—Le Eisenrahm rouge, *Broch.* t. ii. p. 249.—Rother Eisenrahm, *Reuss,* b. iv. s. 76. *Id. Lud.* b. i. s. 244. *Id. Suck.* 2ter th. s. 264. *Id. Bert.* s. 406. *Id. Mohs,* b. iii. s. 385.—Schuppiger Rotheisenstein, *Hab.* s. 116.—Rother Eisenrahm, *Leonhard,* Tabel. s. 65.—Fer oxidé rouge luisant, *Brong.* t. ii. p. 164.—Schuppiger Rotheisenstein, *Karsten,* Tabel. s. 66.—Schaumiger Blutstein, *Haus.* s. 106.—Fer oligiste luisant, *Haüy,* Tabl. p. 95.—Rotheisenrahm, *Hoff.* b. iii. s. 239.—Red scaly Iron-ore, *Aikin,* p. 100.

External Characters.

Its most frequent colour is intermediate between dark steel-grey and brownish-red, which passes on the one side into cherry-red, and on the other into dark steel-grey.

It

It is friable, and consists of semi-metallic shining scaly parts, which are sometimes translucent, and soil strongly.

The particles are more or less coherent, and feel greasy.

Chemical Characters.

It is infusible before the blowpipe without addition, but it communicates to borax an olive and asparagus green colour.

Constituent Parts.

Iron, - - -	66.00
Oxygen, - - -	28.50
Silica, - - -	4.25
Alumina, - - -	1.25
	100 *Henry.*

Bucholz found it to be a pure red oxide of iron, mixed with a little quartz-sand.—*Gehlen's* Journal, 2d series, b. iii. p. 106.

Geognostic Situation.

It occurs in veins in primitive rocks, sometimes also in transition and in secondary rocks. It is usually accompanied with compact and ochry red iron-ore, red hematite, micaceous specular iron-ore, sometimes also magnetic iron-ore, sparry iron, quartz, heavy-spar, and brown-spar.

Geographic Situation.

Europe.—It is found at Ulverstone, and several other places on the borders of Lancashire; in the mine called Oerve-Aase in Norway, along with micaceous specular iron-

iron-ore; Iberg and Blankenberg in the Hartz, with compact red iron-ore; Schmalkalden in Hessia, with brown iron-ore; Schneeberg, with micaceous specular iron-ore; Ehrenfriedersdorf, with magnetic iron-ore; Eibenstock, with ochry red iron-ore; Berggieshübel, with common specular iron-ore; Suhl in Henneberg; and in Silesia, and Hungary.

America.—Chili.

Uses.

At Suhl, in the dutchy of Henneberg, where it occurs in very considerable quantity, it is melted, and yields good iron.

Second Kind.

Ochry Red Iron-ore or Red Ochre.

Ochriger Rotheisenstein, *Werner.*

Ochra Ferri rubra, *Wall.* t. ii. p. 259.—Rotheisenokker, *Wid.* s. 813.—Red Ochre, *Kirw.* vol. ii. p. 171.—Roth Eisenokker, *Emm.* b. ii. s. 317.—Fer oxidé rouge grossier, *Haüy,* t. iv. p. 106, 107.—L'Ocre de Fer rouge, *Broch.* t. ii. p. 256. —Ochriger Rotheisenstein, *Reuss,* b. iv. s. 83. *Id. Lud.* b. i. s. 246. *Id. Suck.* 2ter th. s. 269. *Id. Bert.* s. 408. *Id. Mohs,* b. iii. s. 386. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé rouge ocreux, *Brong.* t. ii. p. 166.—Ochriger Rotheisenstein, *Karsten,* Tabel. s. 66.—Ochriger Blutstein, *Haus.* s. 106.—Rotheisenocker, *Hoff.* b. iii. s. 241.—Red Ochre, *Aikin,* p. 100.

External Characters.

Its colour is light brownish-red, which passes into blood-red.

It

It is usually friable, but in some varieties it approaches and even passes into solid, and occurs as a coating on other ores of iron; also disseminated, and sometimes massive.

It consists of dusty particles, which are dull, or very faintly glimmering.

It soils strongly.

It feels more meagre than greasy.

Its streak is blood-red.

It is easily frangible.

Specific gravity, 2.947, *Wiedemann.*—3.00, *Aikin.*

Geognostic and Geographic Situations.

It occurs in veins, and is almost always accompanied with compact red iron-ore, and red hematite, and sometimes sparry iron, but it is seldom quite pure, being usually mixed with other species of iron-ore.

Its geographic situation is nearly the same as that of the other kinds of red ironstone. It occurs particularly abundant in the Irrgang, near Platte in Bohemia.

Uses.

It melts more easily than any of the other ores of iron, and affords excellent malleable iron.

Observations.

It is characterized by its friability, and dull dusty aspect.

Third

Third Kind.

Compact Red Iron-ore.

Dichter Rotheisenstein, *Werner.*

Hæmatites ruber solidus, *Wall.* t. i. p. 246.—Dichter Rotheisenstein, *Werner,* Pabst. b. i. s. 154. *Id. Wid.* s. 807.—Hématite compacte rouge, *De Born,* t. ii. p. 267.—Compact red Ironstone, *Kirw.* vol. ii. p. 170.—Dichter Rotheisenstein, *Emm.* b. ii. s. 310.—La Mine de Fer rouge Compacte, *Broch.* t. ii. p. 251.—Dichter Rotheisenstein, *Reuss,* b. iv. s. 79. *Id. Lud.* b. i. s. 244. *Id. Suck.* 2ter th. s. 265. *Id. Bert.* s. 406. *Id. Mohs,* b. iii. s. 386. *Id. Hab.* s. 116. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé rouge compact, *Brong.* t. ii. p. 165. —Dichter Rotheisenstein, *Karsten,* Tabel. s. 66.—Gemeiner Blutstein, *Haus.* s. 106.—Fer oligiste compacte, *Haüy,* Tabl. p. 95.—Dichter Rotheisenstein, *Hoff.* b. iii. s. 243.—Compact Red Iron-ore, *Aikin,* p. 100.

External Characters.

Its colour is intermediate between dark steel-grey and blood-red.

It occurs most commonly massive, sometimes also disseminated, specular, with impressions; and in the following supposititious crystals:

1. Acute double six-sided pyramid, from calcareous-spar.
2. Cube, from fluor-spar, and iron-pyrites.

The crystals are middle-sized, small, and sometimes very intimately grown together, and generally hollow.

The specular varieties are smooth and splendent, the others alternate from strongly glimmering to dull, and the high lustre is metallic, the low semi-metallic.

The

The fracture is usually even, from which, although but seldom, it passes into coarse-grained uneven and into large conchoidal, and is sometimes slaty.

The fragments are indeterminate angular, and more or less sharp-edged.

It yields a pale blood-red streak.

It is generally intermediate between hard and semi-hard; sometimes, however, it passes from hard into semi-hard, and nearly into soft.

It is more or less easily frangible.

Specific gravity 4.232, *Breithaupt.*

Physical Character.

When pure, it does not affect the magnet.

Chemical Characters.

It becomes darker before the blowpipe, but is infusible either alone or with glass of borax, to which, however, it communicates an olive-green colour.

Constituent Parts.

Oxide of Iron, -	70.50
Oxygen, - -	29.50
	100.00

Bucholz, in Gehlen's Journ. b. iii. s. 158.

Geognostic Situation.

It occurs in beds and veins in gneiss, clay-slate, grey-wacke, and various secondary rocks, usually associated with red hematite and ochry red iron-ore, quartz, hornstone,

red jasper, and sometimes with red iron-flint, heavy-spar, and calcareous-spar. In some mines it is accompanied with specular iron-ore, or with uran-mica.

Geographic Situation.

Europe.—It occurs in considerable quantity at Ulverstone in Lancashire; in the mine called Oevre-Aase in Norway; at Leerbach, Elbingerode, Andreasberg in the Hartz; Konigsberg, near Giessen in Hessia; at Schellerhau near Altenberg, Schneeberg, Johangeorgenstadt, Eibenstock, Suhl, and Saalfeld, in Saxony; Rudelstadt in Silesia; in several iron-mines in Bohemia, Franconia, Bavaria, Salzburg, Spain, and France.

Uses.

As it affords good cast-iron, and also bar-iron, it is often smelted at iron-works. The slaty variety is the most esteemed as an ore.

Observations.

1. It passes on the one side into Common Specular Iron-ore; on the other into Clay Iron-ore, and sometimes also into Common Jasper.

2. It is characterized by fracture, streak, and weight. It is distinguished from indurated *Tile Ore* by streak, hardness, and geognostic situation.

Fourth

Fourth Kind.

Fibrous Red Iron-Ore, or Red Hematite.

Rother Glaskopf, *Werner.*

Hæmatites ruber, *Wall.* t. ii. p. 247.—Rother Glaskopf, *Werner*, Pabst. b. i. s. 156. *Id. Wid.* s. 811.—Hématite rouge, *De Born*, t. ii. p. 288.—Red Hematites, *Kirw.* vol. ii. p. 168.—Rother Glaskopf, *Emm.* b. ii. s. 313.—L'Hématite rouge, *Broch.* t. ii. p. 254.—Fer oxidé hématite rouge, *Haüy*, t. iv. p. 105. 109. 111, 112.—Fasriger Rotheisenstein, *Reuss*, b. iv. s. 85.—Rother Glaskopf, *Lud.* b. i. s. 245.—Fasriger Rotheisenstein, *Mohs*, b. iii. s. 387. *Id. Hab.* s. 117. *Id. Leonhard*, Tabel. s. 65.—Fer oxidé rouge hematite, *Brong.* t. ii. p. 164.—Fasriger Rotheisenstein, *Karsten*, Tabel. s. 66.—Fasriger Blutstein, *Haus.* s. 106.—Fibrous Hematite, *Kid*, vol. ii. p. 171. —Fer oligiste concretionné, *Haüy*, Tabl. p. 95.—Fasriger Rotheisenstein, or Rothglaskopf, *Hoff.* b. iii. s. 246.—Red Hematite, *Aikin*, p. 100.

External Characters.

Its colour is usually intermediate between brownish-red and dark steel-grey. Some varieties incline to blood-red, others to dark steel-grey, and others to bluish.

It occurs most frequently massive, reniform, botryoidal, stalactitic, and globular ; also in distinct concretions, which are straight, delicate, and stellular or scopiform fibrous ; these are collected into large, small, and fine angulo-granular, and traversed by others which are curved lamellar ; more rarely it occurs in cuneiform prismatic concretions. Sometimes in supposititious crystals, as in double six-sided pyramids from calcareous-spar.

The external surface is generally rough and glimmering, seldom smooth and shining; that of the concretions is either smooth or streaked, and the colour inclines to iron-black, with a shining and metallic lustre.

Internally it is usually glistening, which sometimes passes into glimmering, and the lustre is semi-metallic.

The fragments are commonly cuneiform, seldom, as in the coarse fibrous, splintery.

It is opaque.

The streak is always blood-red.

It is hard, passing into semi-hard.

It is brittle, and rather easily frangible.

Specific gravity, 4.740, *Gellert.*—5.005, *Kirwan.*—4.8983, *Brisson.*—4.840, *Wiedemann.*—5.025, *Ullmann.*

Constituent Parts.

Oxide of Iron, -	90	94
Trace of Oxide of Manganese.		
Silica, - -	2	2
Lime, - - -	1	a trace.
Water, - - -	3	2
	96	98

Daubuisson, Ann. de Chimie, Sept. 1810.

Geognostic Situation.

It occurs in every situation where the compact kind is found, and like it in veins, beds, and lying masses (*liegende stöcke*) that approach in magnitude to mountain-masses, principally in primitive mountains, but also in transition and secondary mountains. The different kinds frequently occur

occur together, both in beds and in veins: in veins, it is the compact and ochry that predominate; the hematite occurs principally in drusy cavities, the walls of which are incrusted with the scaly kind.

Geographic Situation.

Europe.—It occurs in veins that traverse sandstone at Cumberhead in Lanarkshire; in veins in secondary greenstone at Salisbury Craigs, near Edinburgh; at Ulverstone in Lancashire; in Cumberland; and also in Devonshire; and near Bristol in Gloucestershire. It is found in considerable quantity in Saxony, from Berggieshübel to Voightland; in Bohemia, but not so abundantly as in Saxony; Bareuth; Wolfstein in the Palatinate; Silesia; Lauterberg, Walkenried, Andreasberg, Wernigerode in the Hartz; and Salzburg.

Asia.—In Siberia.

America.—Mexico.

Uses.

It affords excellent malleable and cast iron; and when ground, it is also used for polishing tin, silver, and gold vessels, and for colouring iron brown.

Observations.

The name *Hematite*, which is derived from the Greek, αἷμα, *sanguis*, was given to this ore of iron from its red colour.

Third

Third Subspecies.

Red Clay Iron Ore or Stone.

This subspecies is divided into four kinds, viz. Ochry Red Clay Iron-ore, Columnar Red Clay Iron-ore, Lenticular Red Clay Iron-ore, and Jaspery Red Clay Iron-ore.

First Kind.

Ochry Red Clay Iron-Ore, or Red Chalk.

Roethel, *Werner*.

Ochra Ferri rubra, cretacea solida, rubrica, *Wall.* t. ii. p. 260. —Rother Eisenokker, *Wid.* s. 813.—Argile martiale rouge, Sanguine ou Crayon rouge, *De Born,* t. ii. p. 230.—Röthel, *Emm.* b. ii. s. 350.—Argile ocreuse rouge graphique, *Haüy,* t. iv. p. 445, 446.—Le Crayon rouge, *Broch.* t. ii. p. 271.—Röthel, *Reuss,* b. iv. s. 124. *Id. Lud.* b. i. s. 251.—Rother Thoneisenstein, *Suck.* 2ter th. s. 289.—Röthel, *Bert.* s. 425. *Id. Mohs,* b. iii. s. 418. *Id. Leonhard,* Tabel. s. 66.—Ochriger Thoneisenstein, *Karsten,* Tabel. s. 66.—Röthel, *Hoff.* b. iii. s. 275.

External Characters.

Its colour is light brownish-red, which sometimes inclines to cherry-red.

It occurs massive.

The principal fracture is glimmering; the cross fracture is dull.

The principal fracture is rather thick slaty; the cross fracture is fine earthy.

The

The fragments are sometimes tabular, and sometimes splintery.

Its streak is pale blood-red.

It is soft, and very soft.

It soils, and writes.

It is rather sectile.

It is easily frangible.

Specific gravity, 3.391, *Blumenbach.*—3.1391, *Brisson.* 3.805, *Ullmann.*—3.109, *Breithaupt.*

Chemical Characters.

Exposed to a red heat, it decrepitates and becomes black; at the temperature of 159° it melts into a greenish-grey spumous enamel.

Geognostic Situation.

It occurs in thin beds in clay-slate and grey-wacke-slate.

Geographic Situation.

Europe.—It occurs in Hessia, Thuringia, Upper Lusatia, Silesia, and Salzburg.

Asia.—Jelschansk in Siberia.

Uses.

It is principally used for drawing. The coarser varieties are used by the carpenter, the finer by the painter. It is either used in its natural state, or it is pounded, washed, and mixed with gum, and cast into moulds. The crayons thus formed, when intended for coarse drawings, are mixed with but a small portion of gum; but those which are to be used for small and delicate drawings, with

a

a much greater proportion, in order to give them sufficient hardness.

Observations.

1. It is usually called *Red Chalk*, or *Reddle.*
2. It is never smelted as an ore of iron.

Second Kind.

Columnar Red Clay Iron-Ore.

Stänglicher Thoneisenstein, *Werner.*

Id. Werner, Pabst. b. i. s. 167.—Var. of Gemeiner Thoneisenstein, *Wid.* s. 825.—Columnar or Scapiform Iron-ore, *Kirw.* vol. ii. p. 176.—Fer oxidé rouge bacillaire, *Haüy,* t. iv. p. 107.—Le Fer argilleux scapiforme, *Broch.* t. ii. p. 273.—Stänglicher Thoneisenstein, *Reuss,* b. iv. s. 115. *Id. Lud.* b. i. s. 251. *Id. Suck.* 2ter th. s. 283. *Id. Bert.* s. 422. *Id. Mohs,* b. iii. s. 419. *Id. Leonhard,* Tabel. s. 66.—Fer terreux argilleux bacillaire, *Brong.* t ii. p. 173.—Stänglicher Blutstein, *Haus.* s. 106.—Stänglicher Thoneisenstein, *Karsten,* Tabel. s. 66. *Id. Hoff.* b. iii. s. 278.—Columnar Clay Ironstone. *Aikin,* p. 104.

External Characters.

Its colour is brownish-red, which passes on the one side into cherry-red, and on the other into black. Sometimes it has a faint columbine tarnish.

It occurs massive, and also in columnar distinct concretions, which are straight or curved, and thick or thin; usually parallel; sometimes scopiform diverging; and also jointed.

The

The surface of the concretions is rough and dull.

The streak is blood-red.

It is soft.

It is brittle, and uncommonly easily frangible.

It adheres slightly to the tongue.

In single pieces it gives a ringing sound.

It feels very rough.

Specific gravity 3.126–3.422, *Breithaupt.*

Chemical Characters.

It becomes black before the blowpipe, bubbles up with borax, and communicates to it an olive green and blackish colour.

Constituent Parts.

Oxide of Iron, - -	50.00
Water, - - -	13.00
Silica, - - -	32.00
Alumina, - - -	7.00

Brocchi, Trattato, &c. vol. ii. p. 119.

Geognostic and Geographic Situations,

It is a rare mineral, and is in general a pseudo-volcanic product; for it occurs along with earthy-slag, porcelain-jasper, and burnt-clay, in the neighbourhood of pseudo-volcanoes.

It is found at Hoschnitz and Delau, in the Saatzer circle, Straska and Schwintshitz in the circle of Leutmeritz in Bohemia; Amberg in the Upper Palatinate; Dutweiler in Saarbruck.

Third

Third Kind.

Lenticular Red Clay Iron-Ore.

Linsenförmiger Thoneisenstein, *Werner.*

Id. Werner, Pabst. b. i. s. 167. *Id. Wid.* s. 826.—Acinose Iron-ore, *Kirw.* vol. ii. p. 177.—Körniger Thoneisenstein, *Emm.* b. ii. s. 342.—Le Fer argilleux grenu ou lenticulaire, *Broch.* t. ii. p. 274.—Körniger Thoneisenstein, *Reuss,* b. iv. s. 120.—Linsenförmiger Thoneisenstein, *Lud.* b. i. s. 252. *Id. Suck.* 2ter th. s. 285. *Id. Bert.* s. 423. *Id. Mohs,* b. iii. s. 420. *Id. Leonhard,* Tabel. s. 66.—Körniger Thoneisenstein, *Karsten,* Tabel. s. 66.—Körniger Blutstein, *Haus.* s. 106.—Körniger Thoneisenstein, *Hoff.* b. iii. s. 283.—Lenticular Clay Ironstone, (in part), *Aikin,* p. 104.

External Characters.

Its colours are brownish-red, and reddish-brown.

It occurs massive, and in distinct concretions, which are lenticular.

Internally it is always strongly semi-metallic glimmering, which passes into glistening.

On account of the smallness of the concretions, it is difficult to ascertain the kind of fracture, yet it appears to be sometimes fine earthy, and sometimes slaty.

The fragments are indeterminate angular, and blunt-edged.

It yields a red-coloured streak.

It is soft; some varieties pass into very soft; others into semi-hard.

It is brittle, and easily frangible.

Specific gravity, 3.770, 3.810, *Ullmann.*—3.655, *Breithaupt.*

Physical

Physical Character.

The black variety is slightly affected by the magnet.

Constituent Parts.

	From Radnitz in Bohemia.
Oxide of Iron, -	64.0
Alumina, -	23.0
Silica, - -	7.5
Water, - -	5.0
	99.5

Lampadius.

Geognostic Situation.

It occurs principally in beds in an amygdaloid, subordinate to clay-slate and grey-wacke.

Geographic Situation.

It is found in considerable abundance in Bohemia.

Uses.

It melts excellently, and affords a malleable iron nearly as good as that obtained from the best kinds of red iron-ore. It also affords excellent cast-iron.

Fourth

Fourth Kind.

Jaspery Red Clay-Iron-Ore.

Jaspisartiger Thoneisenstein, *Werner*.

Jaspisartiger Thoneisenstein, *Reuss*, b. iv. s. 126. *Id. Lud.* b. i. s. 252. *Id. Suck.* 2ter th. s. 290. *Id. Mohs*, b. iii. s. 422. *Id. Leonhard*, Tabel. s. 66. *Id. Karsten*, Tabel. s. 66.—Jaspisartiger Gelbeisenstein, *Haus.* s. 107.—Jaspisartiger Thoneisenstein, *Hoff.* b. iii. s. 277.

External Characters.

Its colour is reddish-brown, sometimes passing into brownish-red.

It occurs massive.

Internally it is feebly glimmering, sometimes approaching to glistening.

The fracture is large and flat conchoidal.

The fragments are rhomboidal, and sometimes cubical and trapezoidal.

In the streak it becomes somewhat lighter.

It is semi-hard.

It is brittle, and rather easily frangible.

Specific gravity 3.194, *Breithaupt*.

Geognostic and Geographic Situations.

It occurs at Fischau in Austria, where it forms considerable beds in a flœtz or secondary formation.

Observations.

Observations.

1. Its hardness, and shape of its fragments, distinguish it from the other kinds of red clay iron-ore.

2. It is named *Jaspery*, on account of its resemblance to jasper in external aspect.

3. Prismatic Iron-Ore.

Prismatisches Eisen-erz, *Mohs.*

Braun Eisenstein, *Werner.*

This species is divided into four subspecies, Ochry Brown Iron-ore, Compact Brown Iron-ore, Fibrous Brown Iron-ore or Brown Hematite, Brown Clay Iron-ore. * Bog Iron-ore. ** Pitchy Iron-ore. *** Iron-Sinter.

First Subspecies.

Ochry Brown Iron-Ore.

Ockriger Brauneisenstein, *Werner.*

Ochra ferri flava? *Wall.* t. ii. p. 258.—Ochra ferri fusca, *Ibid.* p. 344.—Braune Eisenokker, *Wid.* s. 819.—Brown Iron-Ochre, *Kirw.* vol. ii. p. 167.—Braune Eisenokker, *Emm.* b. ii. s. 327.—Fer oxydé rubigineux pulverulent, *Haüy,* t. iv. p. 108. d.—L'Ocre de Fer brune, *Broch.* t. ii. p. 263.—Ockriger Brauneisenstein, *Reuss,* b. iii. s. 96. *Id. Lud.* b. i. s. 248. *Id. Suck.* 2ter th. s. 275. *Id. Bert.* s. 412. *Id. Mohs,* b. iii. s. 394. *Id. Hab.* s. 119. *Id. Leonhard,* Tabel. s. 65. —Fer oxydé brun ocreux, *Brong.* t. ii. p. 172.—Ochriger Brauneisenstein, *Karsten,* Tabel. s. 66. *Id. Haus.* s. 108.— Fer oxydé pulverulent? *Haüy,* Tabl. p. 98.—Ockriger Brauneisenstein,

eisenstein, *Hoff.* b. iii. s. 254.—Ochrey Brown Iron-ore, *Aikin*, p. 102.

External Characters.

Its colour is light yellowish-brown.

It occurs massive and disseminated.

Internally it is dull.

The fracture is coarse earthy, sometimes approaching to uneven.

It retains its colour in the streak.

It soils slightly.

It is very soft.

It is sectile, and easily frangible.

Constituent Parts.

Peroxide of Iron, - -	83
Water, - - - -	12
Silica, - - - -	5
	100

Daubuisson, Ann. de Chim. Septembre 1810.

Geognostic Situation.

It occurs along with the compact and fibrous subspecies.

Geographic Situation.

It is found at Shotover Hill in Oxfordshire; Kongsberg and Arendal in Norway; Iberg, near Grund in the Hartz; Grosskamsdorf in Saxony; Nassau; Orpes and Kupferberg in Bohemia; Upper Palatinate; Rott in Bavaria; Hüttenberg in Carinthia; Salzburg.

Uses.

Uses.

It affords excellent bar-iron.

Second Subspecies.

Compact Brown Iron-Ore.

Dichter Brauneisenstein, *Weruer.*

Id. Werner, Pabst. b. i. s. 160. *Id. Wid.* s. 815.—Compact Brown Ironstone, *Kirw.* vol. ii. p. 165.—Dichter Brauneisenstein, *Emm.* b. ii. s. 321.—La Mine de Fer brune compacte, *Broch.* t. ii. p. 259.—Dichter Brauneisenstein, *Reuss,* b. iv. s. 93. *Id. Lud.* b. i. s. 247. *Id. Suck.* 2ter th. s. 247. *Id. Bert.* s. 410. *Id. Mohs,* b. iii. s. 394.—Dichter Brauneisenstein, *Hab.* s. 119. *Id. Leonhard,* Tabel. s. 65.—Fer oxidé brun compacte, *Brong.* t. ii. p. 168.—Gemeiner Brauneisenstein, *Karsten,* Tabel. s. 66.—Dichter Brauneisenstein, *Haus.* s. 108. *Id. Hoff.* b. iii. s. 255.—Compact Brown Iron-ore, *Aikin,* p. 102.

External Characters.

Its colour is yellowish-brown and clove-brown. It frequently exhibits a pavonine and bronze-like tarnish.

It occurs massive, disseminated; frequently also cylindrical; and very rarely in supposititious crystals, of which the following are known:

1. Small cube, from common iron-pyrites.
2. Pentagonal dodecahedron, from common iron-pyrites.
3. Double four-sided pyramid, from radiated pyrites.

The crystals are middle-sized and small; the varieties

1,

1, 2. are generally imbedded in a porphyritic manner, and the variety 3. is often aggregated in druses.

The cubes are alternately streaked.

Externally it alternates from shining to dull.

Internally it is dull, or semimetallic glimmering.

The fracture is most commonly even, sometimes also fine-grained uneven.

The fragments are indeterminate angular, and more or less blunt-edged.

The streak is yellowish-brown, passing into ochre-yellow.

It is semi-hard, sometimes inclining to soft.

It is rather brittle, and easily frangible.

Specific gravity, 3.5027, the cubic, } *Brisson*.
3.4771, }
3.551, from Bayreuth, } *Kirwan*.
3.753, from the Tyrol, }
3.073, *Wiedemann*.
3.40, *Daubuisson*.

Chemical Characters.

Before the blowpipe, its colour darkens, and it becomes magnetic; to glass of borax it communicates an olive-green colour.

Constituent Parts.

	Bergzabern.	Vicdessos.	Pyrenees.
Peroxide of Iron,	84	81	81
Water, - -	11	12	11
Oxide of Manganese,	1	—	a trace
Silica, - - -	2	4	2
Alumina, - -	—	—	a trace.
	98	97	94

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Geognostic

Geognostic Situation.

It occurs in the same geognostic situation as the following subspecies. It is always accompanied with ochry and fibrous brown iron-ore.

Geographic Situation.

Europe.—It is found near Sandlodge in Mainland, the largest of the Shetland Islands; in Derbyshire; Lauterberg, and Blankenburg in the Hartz; Schmalkalden in Hessia; Saye and Altenkirchen in Westerwald; Schwarzenberg, Schneeberg, Scheibenberg, Grosskamsdorf, Voightsberg in Voightland; Sahlberg, Konitz, and Suhl, in Thuringia; Nassau; Kupferberg, Auspaner mountains near Pressnitz; Wisterschan near Töplitz; Stiahlan near Rakowa in Bohemia; gold mine near Schreiberau, Silesia; Upper Palatinate; Lower Palatinate; Dutchy of Deux-Ponts; Naila in Bayreuth; Suabia; Tyrol; Salzburg; Stiria; Vellach, Hüttenberg, and Eisenaach, in Carinthia; Hungary; Transylvania; France.

Asia.—Beresof and Catharinenburg in Siberia.

America.—United States.

Uses.

It affords about 50 *per cent.* of iron. It is easily fusible. It affords excellent bar-iron.

Observations.

It is distinguished from *Compact Tile-ore* by its colour; from *Compact Hepatic-ore* by inferior specific gravity.

Third Subspecies.

Fibrous Brown Iron-Ore, or Brown Hematite.

Brauner Glaskopf, *Werner.*

Id. Werner, Pabst. b. i. s. 161. *Id. Wid.* s. 817.—Brown Hematite, *Kirw.* vol. ii. p. 163.—Brauner Glaskopf, *Emm.* b. ii. s. 323.—Fer oxidé Hematite brun, *Haüy,* t. iv. p. 105.—L'Hematite brun, *Broch.* t. ii. p. 261.—Fasriger Brauneisenstein. *Reuss,* b. iv. s. 98.—Brauner Glaskopf, *Lud.* b. i. s. 248. *Id. Suck.* 2ter th. s. 273. *Id. Bert.* s. 411. *Id. Mohs,* b. iii. s. 400. —Fasriger Brauneisenstein, *Hab.* s. 120.—Fer oxydé brun fibreux, *Brong.* t. ii. p. 168.—Fasriger Brauneisenstein, *Karsten,* Tabel. s. 66. *Id. Haus.* s. 107.—Brown hematitic Iron-ore, *Kid,* vol. ii. p. 176.—Fer oxidé hematite, & Fer oxidé noire vitreux, *Haüy,* Tabl. p. 98.—Fasriger Brauneisenstein. *Hoff.* b. iii. s. 258.—Brown Hematite, *Aikin,* p. 101.

External Characters.

The surface of the fresh fracture is clove-brown, which in some varieties passes into blackish-brown, hair-brown, and in others into yellowish-brown. The external surface is tarnished velvet-black and bluish-black; sometimes also steel-grey, pinchbeck-brown, pavonine, and iridescent.

It seldom occurs massive, more frequently stalactitic, coralloidal, reniform, botryoidal, tuberose; sometimes also cylindrical, fructicose, dendritic, large and small cellular; also in distinct concretions, which are delicate fibrous, and generally stellular and scopiform: these are collected into other concretions which are longish granular and lamellar,

and

and the lamellar intersect the granular concretions. It sometimes occurs in double six-sided pyramids, being supposititious crystals from calcareous-spar; and also in true crystals. The primitive form is an oblique four-sided prism, the dimensions of which have not been ascertained. This prism occurs in small capillary crystals, which form druses.

The external surface of the particular external shapes is sometimes smooth, sometimes granulated, but seldom rough or drusy.

Externally it is usually splendent.

Internally it is glimmering, sometimes passing into glistening; and the lustre is intermediate between pearly and resinous.

The fragments are sometimes splintery; sometimes wedge-shaped: seldom indeterminate angular.

It is generally opaque; the brownish-black variety is weakly translucent on the edges.

The streak is pale yellowish-brown.

It is harder than apatite, but not so hard as felspar.

It is brittle, and easily frangible.

Specific gravity, 3.789, *Gellert.*—3.951, *Kirwan.*—4.029, *Wiedemann.*—3.764, *Breithaupt.*

Chemical Characters.

It becomes black before the blowpipe, and dissolves with some ebullition in glass of borax, to which it communicates an olive-green colour.

Constituent Parts.

Fibrous.

	Bergzabern.	Vicdessos.
Peroxide of Iron,	79	82
Water, - -	15	14
Oxide of Manganese,	2	2
Silica, - -	3	1
	99	99

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Resinous and Conchoidal.

Oxide of Iron,	80.25
Water, - -	15.00
Silica, - -	3.75
	99.00

Vauquelin, Haüy, Tabl. Comp. 274.

Observations.

Brown Iron-ore is readily distinguished from *Red Iron-ore*, by its yellow streak, and inferior specific gravity; also by the water which it contains, it being a hydrate of iron: further brown iron-ore is generally associated with sparry iron, but rarely with red iron-ore.

Chemical Properties, Geognostic and Geographic Situations of the three preceding Subspecies.

A. *Chemical Properties, &c.*

1. These subspecies of iron-ore melt easily, and afford usually from 40 to 60 *per cent.* of iron. The cast-iron which they afford is indifferent, and the vessels made of it are not so fine as those manufactured from the cast-iron of red iron-ore, and other ores of iron. The wrought iron obtained from these ores is very malleable, and at the same time hard: hence it is advantageously used in cases where softer iron would not answer. It also affords excellent steel, which is conjectured to be owing to the manganese it contains.

2. When they are intermixed with quartz, they afford a cold-short iron; but if with copper-pyrites, a red-short iron

iron. It would appear, however, to require a greater quantity of sulphur to produce red-short iron from these subspecies than from most of the other ores of iron, and this is conjectured to be owing to the manganese which they contain.

3. They melt usually without a flux; and when one is necessary, clay-slate is that which is generally used.

B. *Geognostic Situation.*

They occur in primitive, transition, and secondary mountains, but more frequently in the two latter: and when in primitive mountains, in those only which are considered as of newer formation. Their repositories are veins, beds, lenticular masses *(liegende stöke)*, and mountain-masses *(stüke gebirge)*. When they occur in veins and lying masses, the compact and ochry subspecies form the principal part of the mass. The brown hematite occurs often in cavities in these veins or beds. They are usually accompanied with sparry iron, calcareous-spar, brown-spar, and heavy-spar; less frequently with black hematite, and rarely with quartz, and red iron-ore. Quartz, which occurs so frequently with red iron-ore, seldom appears with brown iron-ore: on the contrary, it is accompanied with heavy-spar, calcareous-spar, and in some places with fluor-spar.

C. *Geographic Situation.*

Europe.—They occur in veins in sandstone, along with heavy-spar, at Cumberhead in Lanarkshire; in a similar repository in Mainland, one of the Shetland Islands; and in the Island of Hoy, one of the Orkney group. Small veins filled with these ores are met with in the flœtz greenstone of Salisbury Craigs, near Edinburgh. They also occur

cur at Schneebrg, Scheibenberg and Raschau in the Erzgebirge; and at Kamsdorf, where they (principally the ochry subspecies) occur in flœtz rocks, in beds, which are sometimes so thick that they nearly form lying masses. A part of this deposition passes into Schwarzburg, as far as Pönitz, and even reaches to Henneberg, where there are very extensive ironworks. Further, they are found in very considerable quantity all around the Fichtelgebirge, and there are ironworks for smelting these ores, both on the Saxon and Bohemian sides, and in that part of it which belongs to Bayreuth. They occur in beds in the Upper Palatinate, and in Franconia. They are less abundant in the Hartz, where, at Iberg near Grün, the ochry brown iron-ore occurs in *putzenwerke* in limestone. Very considerable mines of these ores are met with in Nassau, Hessia, and Westerwald; and they also occur in the Tyrol, Carinthia, Stiria, Upper Italy, and in the southern provinces of France.

It may be remarked, that northern countries, such as Sweden and Lapland, which possess so great an abundance of magnetic iron-ore and specular iron-ore, contain but small quantities of this species, which occurs so abundantly in the Hartz, Stiria, Carinthia, Hungary, Saxony, Westphalia, the county of Nassau, and other districts.

Fourth Subspecies.

Brown Clay Iron-Ore.

This subspecies is divided into five kinds, viz. Common Brown Clay Iron-ore, Pisiform Brown Clay Iron-ore, Reniform

niform Brown Clay Iron-ore, Granular Brown Clay Iron-ore, and Umber.

First Kind.

Common Brown Clay Iron-ore.

Gemeiner Gelbeisenstein, *Haus.* b. i. s. 282.

External Characters.

Its colours are yellowish-brown and yellowish-grey; also ochre-yellow.

It occurs massive.

Internally it is dull or feebly glimmering.

The fracture is large and flat conchoidal; also even and uneven.

It is opaque.

The fragments are indeterminate angular and blunt edged.

Its streak is brown, inclining to grey.

It is soft; or soft passing into semi-hard.

Constituent Parts.

Oxide of Iron, - -	69
Oxide of Manganese, -	3
Water, - - - -	13
Silica, - - - -	10
Alumina, - - -	3
	98

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Geognostic

Geognostic and Geographic Situations.

It occurs in England; also in Saxony, Bohemia, Silesia, and Westphalia, in beds in secondary rocks.

Second Kind.

Pisiform Brown Iron-Ore or Pea-Ore.

Bohnerz, *Werner.*

Minera Ferri subaquosa globosa, *Wall.* t. ii. p. 257.—Mine de Fer en grains, *Romé de Lisle*, t. iii. p. 300.—Bohnerz, *Werner*, Pabst. b. i. s. 168. *Id. Wid.* s. 827.—Pisiform or granular Ironstone, *Kirw.* vol. ii. p. 178.—Bohnerz, *Emm.* b. ii. s. 347.—Fer oxydé rubigineux globuliforme, *Haüy*, t. iv. p. 111.—Le Fer pisiforme, *Broch.* t. ii. p. 280.—Kuglicher Thoneisenstein, *Reuss*, b. iv. s. 135. *Id. Lud.* b. i. s. 254. *Id. Suck.* 2ter th. b. ii. s. 288. *Id. Bert.* s. 424. *Id. Mohs*, b. iii. s. 426.—Hagelförmig, körniger, thoniger Brauneisenstein; Braunes Bohnerz, *Hab.* s. 122.—Bohnerz, *Leonhard*, Tabel. s. 67.—Fer oxidé brun granuleux, *Brong.* t. ii. p. 170.—Kuglicher Thoneisenstein, *Karsten*, Tabel. s. 66.—Kuglicher Gelbeisenstein, *Haus.* s. 107.—Pea-ore, *Kid*, vol. ii. p. 181.—Fer oxidé globuliforme, *Haüy*, Tabl. p. 98.—Körniger Gelbeisenstein, *Haus.* Handb. b. i. s. 281.—Bohnerz, *Hoff.* b. iii. s. 288.—Pisiform Clay Ironstone, *Aikin*, p. 104.

External Characters.

Internally its colour is yellowish-brown of different degrees of intensity, which sometimes passes into blackish-brown. Externally it is reddish, yellowish, and liver brown, and sometimes yellowish-grey, which are, however, accidental,

dental, as they depend on the kind of clay in which it is imbedded.

It occurs in small spherical round grains, which are not hollow, and these are composed of concentric curved lamellar concretions.

Internally it passes from dull to glistening, in such a manner that the centre of the grain is dull, and the lustre increases in strength towards the surface; the lustre is resinous.

The fracture is fine earthy in the centre of the grain, but towards the surface even.

The fragments are indeterminate angular, and not particularly sharp-edged.

The streak is yellowish-brown.

It is soft.

It is rather brittle, and easily frangible.

Specific gravity, 3.142, *Breithaupt.*

Constituent Parts.

	Pené, in the district of Gaillac.	Mardorf.
Oxide of Iron,	48	60
Alumina,	31	13
Silica, -	15	12
Water, -	6	15
	100	100
	Vauquelin, Journ. des Mines, xii.	*Mollinghof*, Crell's Annalen 1802, s. 110.

	Hogau.	Berri.
Oxide of Iron,	53.00	70
Oxide of Manganese,	1.00	trace
Alumina, -	23.00	7
Silica - -	6.50	6
Water, -	14.50	15
	98.00	98
	Klaproth, Beit. b. iv. s. 131.	*Daubuisson*, Annal. de Chim. for 1810.

Geognostic Situation.

It occurs in hollows in shell limestone.

Geographic

Geographic Situation.

It is found at Galston in Ayrshire. On the Continent, it occurs at Eichstadt in Franconia; Mardorf near Homburg in Hessia; Nardern, Duttlengen, Heerbrechtlingen in Suabia; Basle, Aarau near Bern, and in the Jura mountains, where it occurs in an extensive bed, which rests on limestone; Salzburg; Alsace, Burgundy, Languedoc, &c. in France; Dalmatia; also in Smoland in Sweden.

Uses.

It yields from 30 to 40 *per cent.* of iron; and at Aarau it supplies very considerable ironworks. In Dalmatia, it is said to be used by the inhabitants in place of shot.

Observations.

1. It is distinguished from *Reniform Brown Clay Iron-ore* by its form.
2. It is named in Sweden, Myrmalm, Sjömalm, Pennigmalm, and Skragmalm.

Third Kind.

Reniform or Kidney-shaped Brown Clay Iron-ore.

Eisenniere, *Werner.*

Ætites, *Wall.* t. ii. p. 614.—Pierre d'Aigle, *Romé de Lisle*, t. iii. p. 300.—Eisenniere, *Werner*, Pabst. b. i. s. 167.—Var. of Bohnerz, *Wid.* s. 827.—Nodular Ironstone, *Kirw.* vol. ii. p. 178.—Fer limoneux spheroïdal, *De Born*, t. ii. p. 283.—Eisenniere, *Emm.* b. ii. s. 344.—Pierre d'Aigle, *Lam.* t. i. p. 245.

p. 245.—Fer oxydé rubigineux geodique, *Haüy*, t. iv. p. 107, &c.—Le Fer reniforme, *Broch.* t. ii. p. 278.—Eisenniere, *Reuss*, b. iv. s. 132. *Id. Lud.* b. i. s. 253. *Id. Suck.* 2ter th. s. 286. *Id. Bert.* s. 423. *Id. Mohs*, b. iii. s. 425. *Id. Leonhard*, Tabel. s. 67.—Fer oxidé brun ætite, *Brong.* t. ii. p. 169.—Schaaliger Thoneisenstein, *Karsten*, Tabel. s. 66.—Schaaliger Gelbeisenstein, *Haus.* s. 107.—Ætites or Eaglestone, *Kid*, vol. ii. p. 181.—Fer oxydé geodique, *Haüy*, Tabl. p. 98.—Eisenniere, *Hoff.* b iii. s. 286.

External Characters.

Its colour is yellowish-brown, but it shews various degrees of intensity, even in the same specimen: externally it is darker, approaching to blackish-brown; internally the colour is very light, and sometimes it includes an ochre-yellow kernel.

It occurs massive, in irregular single balls, also in reniform, lenticular and elliptical forms, which are sometimes hollow. These forms are composed of concentric lamellar concretions, which often include a loose nodule.

The lustre of the external layers is glimmering and semi-metallic; that of the internal layers is dull; the surface of the concretions is rough and glimmering.

The fracture towards the interior is fine earthy; towards the exterior, even; in the dark yellowish-brown varieties, nearly conchoidal; that of the ochre-yellow, even.

The fragments are indeterminate angular.

The external layers are soft, sometimes inclining to semi-hard; the internal very soft, sometimes inclining to friable.

The streak is pale yellowish-brown, bordering on ochre-yellow, and is glistening.

It is rather sectile, and easily frangible.

Constituent

Constituent Parts.

Peroxide of Iron, - - - -	76	78
Water, - - - - -	14	13
Silica, - - - - - -	5	7
Oxide of Manganese, - - -	2	trace
Alumina, - - - - -		1
Lime, - - - - - -		trace
	97	99

Daubuisson, Ann. d. Chimie for 1810

Geognostic Situation.

It occurs imbedded in ironshot clay, in secondary rocks of different kinds, and also in loam and clay beds that lie over black coal.

Geographic Situation.

Europe.—It is found in different places in the counties of Mid-Lothian and East Lothian; at Colebrookedale in England; Norway; Denmark; at Wehrau in Upper Lausitz; Bohemia; Upper Palatinate; Oppeln, Beuthen, Tarnowitz, in Silesia; Mountains of Cracau in Poland; Transylvania; and France.

Asia.—Siberia.

Uses.

It is one of the best kinds of ironstone, yields an excellent iron, and is smelted in many places.

Fourth

Fourth Kind.

Granular Brown Clay Iron-Ore.

External Characters.

Its colour is yellowish and reddish-brown.

It occurs massive, and in small globular united grains.

The fracture is thick slaty.

The streak is yellowish-brown.

It is soft.

It is rather brittle, and very easily frangible.

Specific gravity, 3.005, *Breithaupt.*

Geognostic and Geographic Situations.

It occurs in beds between the red sandstone of the salt formation and the lias limestone. It often contains petrifactions of shells. It is found in Bavaria, Salzburg, the Tyrol, and France.

Uses.

It affords about 40 *per cent.* of good iron

Fifth Kind.

Umber.

External Characters.

Its colour is clove-brown, which passes into blackish-brown and yellowish-brown.

It

It occurs massive.
Internally it is dull or glimmering, and resinous.
The fracture is flat conchoidal, passing into fine earthy.
The fragments are blunt-edged.
It is soft, inclining to very soft.
It is rather sectile.
It soils strongly.
It is very easily frangible.
It feels meagre.
It adheres strongly to the tongue.
It readily falls to pieces in water.
Specific gravity 2.060, *Ullmann*.

Constituent Parts.

	From Cyprus.
Oxide of Iron, - -	48
Oxide of Manganese, -	20
Silica, - - - - -	13
Alumina, - - -	5
Water, - - - - -	14
	100

Klaproth, Beit. b. iii. s. 140

Geognostic and Geographic Situations.

It occurs in beds in the Island of Cyprus.

Uses.

It is used as a pigment.

Observations.

Other minerals are known under the name Umber, particularly Earth-coal, the Humus umbra of Wallerius.

* Bog Iron-Ore.

Raseneisenstein, *Werner*.

There are three kinds of this ore, viz. Morass-ore, Swamp-ore, and Meadow-ore.

First Kind.

Meadow-Ore, or Friable Bog Iron-Ore.

Morasterz, *Werner*.

Id. Werner, Pabst. b. i. s. 168. *Id. Wid.* s. 830.—Morassy Iron-ore, *Kirw.* vol ii. p. 183.—Morasterz, *Emm.* b. ii. s. 352.—Fer oxydé rubigineux massif, *Haüy*, t. iv. p. 138.—La Mine des Marais, ou le Morasterz, *Broch.* t. ii. p. 283.—Morasterz, *Reuss*, b. iv. s. 138. *Id. Lud.* b. i. s. 254. *Id. Mohs*, b. iii. s. 431. *Id. Leonhard*, Tabel. s. 67.—Fer oxidé limoneux, le Mine des Marais, *Brong.* t. ii. p. 174.—Zerreiblicher Raseneisenstein, *Karsten*, Tabel. s. 66.—Lowland Iron-ore, *Kid.* vol. ii. p. 182.—Morasterz, *Hoff.* b. iii. s. 292.

External Characters.

Its colour is pale yellowish-brown, which frequently passes into ochre-yellow.

It is sometimes friable, sometimes nearly coherent.

The coherent varieties occur massive, corroded, in grains, and sometimes tuberose. The friable is composed of dull dusty particles.

The coherent varieties are externally and internally dull.

The fracture is earthy.

It

It soils pretty strongly.

It feels meagre, but fine.

It is light.

Observations.

It is characterised by colour, dull earthy aspect, and low specific gravity.

Second Kind.

Swamp-Ore, or Indurated Bog Iron-Ore.

Sumpferz, *Werner.*

Id. Werner, Pabst. b. i. s. 168. *Id. Wid.* s. 831.—Swampy Iron-ore, *Kirw.* vol. ii. p. 183.—Sumpferz, *Emm.* b. ii. s. 353.—La Mine des Lieux bourbeux, ou le Sumpferz, *Broch.* t. ii. p. 283. —Sumpferz, *Reuss,* b. iv. s. 140. *Id. Lud.* b. i. s. 254. *Id. Mohs,* b. iii. s. 43. *Id. Leonhard,* Tabel. s. 67.—Fer oxidé limoneux, la Mine des lieux bourbeux, *Brong.* t. ii. p. 174.—Verhärteter Raseneisenstein, *Karsten,* Tabel. s. 66.—Sumpferz, *Hoff.* b. iii. s. 295.

External Characters.

Its colour is dark yellowish-brown, sometimes passing into dark yellowish-grey.

It occurs corroded and vesicular, also amorphous.

Internally it is commonly dull, but the darker varieties are glimmering, and sometimes even glistening.

The fracture is earthy, sometimes passing into fine-grained uneven.

The fragments are indeterminate angular, and blunt-edged.

 The

The streak is yellowish-brown.

It is very soft.

It is sectile.

It is easily frangible.

Specific gravity, 2.944, from Sprottau, *Kirwan.*

Observations.

It is distinguished from the preceding kind by its greater specific gravity, and greater compactness.

Third Kind.

Meadow-Ore, or Conchoidal Bog Iron-Ore.

Weisenerz, *Werner.*

Id. Werner, Pabst. b. i. s. 168. *Id. Wid.* s. 832.—Meadow Iron-ore, *Kirw.* vol. ii. p. 182.—Wiesenerz, *Emm.* b. ii. s. 354.—La Mine des Prairies, ou le Weisenerz, *Broch.* t. ii. p. 284.—Weisenerz, *Reuss,* b. iv. s. 142. *Id. Lud.* b. i. s. 256. *Id. Mohs,* b. iii. s. 432. *Id. Leonhard,* Tabel. s. 67.—Fer terreux limoneux, la Mine des Prairies, *Brong.* t. ii. p. 174.—Muschlicher Raseneisenstein, *Karsten,* Tabel. s. 66.—Limonite, *Haus.* s. 107.—Weisenerz, *Hoff.* b. iii. s. 297.

External Characters.

On the fresh fracture it is blackish-brown, which sometimes passes into brownish-black. Externally it has different colours, according to the earth in which it is found.

It occurs massive, in roundish grains, perforated, tuberose, and amorphous.

Internally it extends from shining to glistening, and the lustre is resinous.

The fracture is usually imperfect and small conchoidal, from which it sometimes passes into small-grained uneven; the uneven sometimes inclines to earthy.

The fragments are indeterminate angular, and blunt-edged.

It yields a light yellowish-grey streak.

It is soft.

It is rather brittle, and easily frangible.

Specific gravity 2.603, *Karsten*.

Constituent Parts.

Oxide of Iron,	66.00	Oxide of Iron,	61.0
Oxide of Manganese,	1.50	Oxide of Manganese,	7.0
Phosphoric Acid,	8.00	Phosphoric Acid, with a trace of Sulphur,	2.5
Water, - -	23.00	Water, - -	19.0
	98.50	Silica, - -	6.0
Klaproth, Beit. b. iv. s. 127.		Alumina, -	2.0
			97.5
		Daubuisson, Annal. de Chim. 1800.	

It would appear from the experiments of Vauquelin, that this ore also contains Chrome, Magnesia, Silica, Alumina, and Lime; and the late experiments of Lescherin shew, that Zinc and Lead also occasionally occur in it. These last mentioned ingredients must be accidental.—Vid. Annal. du Mus. t. viii. p. 435,–460.; also Journ. des Mines, t. 31. p. 45. to 54.

Geognostic Situation.

This ore belongs to a very new formation. According to Werner, it is formed in the following manner:—The water

water which flows into marshy places is impregnated with phosphoric acid, formed from decaying animal and vegetable matter, which enables it to dissolve the iron in the rocks over which it flows, or over which it stands. This water having reached the lower points of the country, or being poured into hollows, becomes stagnant, and by degrees evaporates; the dissolved iron being accumulated in quantity by fresh additions of water, there follow successive depositions, which at first are yellowish, earthy, and of little consistence, and this is *Morass-ore*; but in course of time they become harder, their colour passes to brown, and thus *Swamp-ore* is formed. After the water has completely evaporated, and the swamp is dried up, the swamp-ore becomes much harder, and at length passes into *Meadow-ore*, which is already covered with soil and grass *.

From the preceding observations, it is evident that there is a complete transition of the different kinds of bog iron-ore into each other, and that masses may be found in which we can observe the different degrees of induration.

Geographic Situation.

It is found in various places in the Highlands of Scotland, in the Hebrides, and Orkney and Shetland Islands. In Saxony it occurs at Torgau; in Upper and Lower Lusatia; in a part of the Mark Brandenburg; in Mecklenburg; Pomerania; and in the kingdom of Hanover. It also extends through Prussia, Poland, Courland, Liefland, into Russia, and the southern parts of Sweden, particularly in Smoland, where it is found in very considerable quantity. It is also found in small quantity in the northern parts

* In some of the Swedish lakes, this ore is deposited so abundantly, that it is dredged up every twenty or thirty years.—Vid. Swedenborg's Regnum Subterraneum.

parts of Westphalia; in Silesia; in the island of Seeland in the Baltic; in the Upper Palatinate; and Hungary.

It occurs in general more abundantly in the northern than in the western and southern European countries.

Uses.

The three kinds of ore appear different in working. The Morass-ore is the most easily fusible, and also affords the best iron. The Meadow-ore is more difficultly fusible. When melted with other ores of iron, red and brown ironstone are to be preferred. Of these the ochry kind smelts the most advantageously; but where these cannot be obtained, and we are obliged to use the compact and hematitical kinds, we must be careful that they be previously well roasted. Even in the first melting, bog-iron affords an iron for the finest kinds of cast-ware. Owing, however, to the phosphoric acid it contains, this iron is not so tenacious as that obtained from some other ores. The malleable iron prepared from this mineral, has always a tendency to be cold-short, and can scarcely be used for plate-iron, and never for iron-wire. It is however well fitted for nails, because it takes a good point, and welds well. The usual flux is limestone.

** Pitchy Iron-Ore.

Eisenpecherz, *Hoffmann*.

Triplit, *Hausmann*.—Mangan phosphaté, *Haüy*.—Eisenpecherz, *Hoff.* b. iii. s. 300.

External Characters.

Its colours are blackish-brown and brownish-black.

It

It occurs massive and disseminated.

Internally it is shining or glistening, and the lustre is resinous, inclining to adamantine.

The fracture is imperfect flat conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is translucent on the edges, or opaque.

It is hard.

The streak is yellowish-grey.

It is brittle, and easily frangible.

Specific gravity, 3.562, *Breithaupt.*—3.430, *Vauquelin.*

Constituent Parts.

Phosphoric Acid,	-	-	27
Manganese,	-	-	42
Oxide of Iron,	-	-	31
			100

Vauquelin, Journal des Mines, N. 64. p. 299.

Geognostic and Geographic Situations.

It occurs at Chauteloube, near Limoges in France, in a quartz vein in granite, along with massive beryl.

Observations.

This mineral is different from the *Eisenpecherz* of Karsten, of which a description follows.

*** Iron-Sinter.

*** Iron-Sinter.

Eisen-Sinter, *Werner*.

Fer oxydé resinite, *Haüy*.—Eisenpecherz, *Karsten*.—Pittizit, *Hausmann*.

External Characters.

Its colours are yellowish, reddish, and blackish-brown.

It occurs massive, in crusts, reniform, and stalactitic; and occasionally in thin and curved lamellar concretions.

Internally it is shining or glistening, and the lustre is resinous.

The fracture is flat conchoidal, sometimes inclining to even.

The fragments are indeterminate angular, and rather sharp-edged.

It alternates from transparent to translucent on the edges.

It is soft.

It is rather brittle, and uncommonly easily frangible.

Specific gravity 2.40, *Karsten*.

Constituent Parts.

Water, - -	25	38.25
Oxide of Iron, -	67	55.00
Sulphuric Acid, -	8	6.25
	100	99.50
	Klaproth.	*Zellner.*

Geognostic

Geognostic and Geographic Situations.

It occurs in the galleries of old mines in Saxony and Silesia.

Observations.

1. It is characterized by its colour, form, lustre, fracture, and low specific gravity.

2. It is distinguished from *Brown Iron-ore*, by its inferior hardness and weight; and from *Opal* and *Opal Jasper* also by its inferior hardness, and more easy frangibility.

3. It appears to be formed by the decomposition of iron-pyrites.

Genus X.—MANGANESE-ORE.

Mangan-erz, *Mohs.*

This Genus contains but one species, viz. Prismatic Manganese ore.

1. Prismatic Manganese-Ore.

Prismatisches Mangan-erz, *Mohs.*

This species contains three subspecies, viz. Grey Manganese-ore, Black Manganese-ore, and Scaly Brown Manganese-ore.

First

First Subspecies.

Grey Manganese-Ore.

Grau Braunsteinerz, *Werner.*

This Subspecies is divided into five kinds, viz. Fibrous Grey Manganese-ore, Radiated Grey Manganese-ore, Foliated Grey Manganese-ore, Compact Grey Manganese-ore, and Earthy Grey Manganese-Ore.

First Kind.

Fibrous Grey Manganese-Ore.

Faseriges Grau-Braunsteinerz, *Werner.*

Haarförmiges Grau-Braunstein, *Mohs,* b. iii. s. 449. *Id. Haus.* Handb. b. i. s. 290.—Faseriges Grau-Braunsteinerz, *Ullmann,* System. Tabell. Ubers. s. 402.

External Characters.

Its colour is dark steel-grey, passing into iron-black.

It occurs massive, disseminated, in crusts, reniform, botryoidal, also in distinct concretions, which are stellular, scopiform, and promiscuous fibrous, and these again are collected into others which are coarse granular or wedge-shaped, prismatic. It also occurs crystallized in very delicate capillary and acicular crystals, and in very thin and long rectangular four-sided tables, in which the longer terminal planes are set on obliquely.

The crystals are small and very small, and scopiformly or promiscuously aggregated.

The lateral planes of the crystals are generally longitudinally

dinally streaked; the surface of the particular external shapes is very delicately drusy.

Externally it is glistening, passing into glimmering; the crystals are shining and splendent.

Internally it is glistening, or shining, and the lustre is metallic.

The fragments are indeterminate angular, and blunt-edged, or wedge-shaped.

The streak is dull and black.

It soils strongly.

It is soft.

It is brittle, and easily frangible.

Geognostic and Geographic Situations.

It occurs in several veins of brown ironstone in the Westerwald; also at Stahlberg, near Schmalkalden in Saxony; and Christiansand in Norway.

Second Kind.

Radiated Grey Manganese-Ore.

Strahliges Grau Braunsteinerz, *Werner.*

Magnesia fuliginosa striata, *Wall.* Syst. Min. t. ii. p. 329.—Strahliges Grau Braunsteinerz, *Wern.* Pabst. b. i. s. 216. *Id. Wid.* s. 948.—Striated Grey Ore of Manganese, *Kirw.* vol. ii. p. 291.—Strahliges grau Braunsteinerz, *Emm.* b. ii. s. 522. Le Manganese gris rayonné, *Broch.* t. ii. p. 414.—Manganese oxidé metalloide, *Haüy,* t. iv. p. 246.—Strahliges Graubraunsteinerz, *Reuss,* b. i. s. 448. *Id. Lud.* b. i. s. 291. *Id. Mohs,* b. iii. s. 442. *Id. Leonhard,* Tabel. s. 69.—Manganese metalloide chalybdin, *Brong.* t. ii. p. 107.—Strahliges Grau Manganerz,

Manganerz, *Karsten,* Tabel. s. 72.—Strahliger Braunstein, *Haus.* s. 108.—Manganese oxidé metalloide gris, *Haüy,* Tabl. p. 110.—Strahliger Grauer Braunstein, *Hoff.* b. iii. s. 138.—Grey Manganese, *Aikin,* p. 131.

External Characters.

Its colour is dark steel-grey, which inclines more or less to iron-black, and in some rare varieties to pale steel-grey. It is sometimes tarnished with pitch-black, velvet-black, or tempered-steel colours.

It occurs massive, reniform, botryoidal, disseminated; also in distinct concretions, which are scopiform and stellular radiated, and these are again collected into others which are granular or wedge-shaped. It is sometimes crystallized. The primitive figure is an oblique four-sided prism, in which the largest angle is about 100°. The following are the secondary forms:

1. Oblique four-sided prism, in which the obtuse edges are either bevelled or rounded off, so that it acquires a reed-like form. The prism is generally variously modified on the extremities.
   a. Prism flatly bevelled on the extremities, the bevelling planes set on the obtuse lateral edges; and sometimes the proper edge of the bevelment is truncated.
   b. Sometimes the prism is acutely acuminated on the extremities with four planes, which are set on the lateral planes.
2. The crystals are sometimes spicular.

The surface of the crystals is longitudinally streaked, and shining, passing to splendent.

Internally

Internally it is glistening and shining, and the lustre is metallic.

The cleavage is prismatic.

The fragments in the small are wedge-shaped and splintery, but in the great, indeterminate angular and blunt-edged.

The streak is black and dull.

When rubbed it soils strongly.

It is soft.

It is brittle, and rather difficultly frangible.

Specific gravity, 4.2491 to 4.7563, *Brisson.*—4.264–4.316, *Breithaupt.*—4.4–4.8, *Mohs.*

Constituent Parts.

	Ilefeld.	Moravia.
Black Oxide of Manganese,	90.50	89.00
Oxygen, - - -	2.25	10.25
Water, - - -	7.00	0.50
	99.75	99.75

Klaproth, Beit. b. iii. s. 308. & 310.

Geographic Situation.

Europe.—It occurs in the vicinity of Aberdeen; also in Cornwall, Devonshire, Somersetshire and Derbyshire; Christiansand in Norway; Nassau; Ilefeld in the Hartz; Ilmenau and Saalfeld in Thuringia; Konradswaldau, Kupferberg, &c. in Silesia; Miess in Bohemia; Hüttenberg in Carinthia; St Gothard in Switzerland; Piedmont; and Ischio near Vicenza in Italy.

Asia.—Kolyvan in Siberia.

Third Kind.

Foliated Grey Manganese-Ore.

Blâttriges Grau Braunsteinerz, *Werner.*

Id. Werner, Pabst. b. i. s. 218. *Id. Emm.* b. ii. s. 525.—Le Manganese gris lamelleux, *Broch.* t. ii. p. 417.—Blättriges Grau Braunsteinerz, *Reuss,* b. iv. s. 453. *Id. Lud.* b. i. s. 292. *Id. Mohs,* b. iii. s. 447. *Id. Leonhard,* Tabel. s. 69.—Manganese metalloide chalybin, texture lamelleuse, *Brong.* t. ii. p. 108. —Blättriges Grau Manganerz, *Karsten,* Tabel. s. 72.—Blättricher Braunstein, *Haus.* s. 108. *Id. Hoff.* b. iii. s. 144.

External Characters.

Its colour is intermediate between steel-grey and iron-black.

It occurs massive, disseminated; also in granular distinct concretions; and crystallized in short oblique four-sided prisms, of the same varieties as in the former kind.

Internally it alternates from shining to splendent, and the lustre is metallic.

The cleavage is prismatic.

The fracture is uneven.

The fragments are indeterminate angular, and blunt-edged.

It yields a dull black streak.

It soils.

It is soft.

It is brittle, and easily frangible.

Specific gravity 3.742, *Hagen.*

Geographic Situation.

It is found in Devonshire; Ilefeld in the Hartz; Johanngeorgenstadt in the kingdom of Saxony; Bohemia; Salzburg; and Transylvania.

Fourth Kind.

Compact Grey Manganese-ore.

Dichtes Grau Braunsteinerz, *Werner.*

Id. Werner, Pabst. b. i. s. 219.—Indurated Grey Ore of Manganese, *Kirw.* vol. ii. p. 249.—Le Manganese gris compacte, *Broch.* t. ii. p. 418.—Dichtes Graubraunstein, *Reuss,* b. iv. s. 454. *Id. Lud.* b. i. s. 293. *Id. Mohs,* b. iii. s. 447. *Id. Leonhard,* Tabel. s. 69.—Manganese terne compact, *Brong.* t. ii. p. 109.—Dichtes Graumanganerz, *Karsten,* Tabel. s. 72. —Dichter Braunstein, *Haus.* s. 109.—Manganese oxydé gris compacte, *Haüy,* Tabl. p. 110.—Dichter grau Braunstein, *Hoff.* b. iii. s. 146.—Compact Grey Manganese, *Aikin,* p. 132.

External Characters.

Its colour is intermediate between iron-black and steel-grey.

It occurs massive, seldom disseminated, or small botryoidal, and dendritic and fruticose.

Internally it is glistening, passing into glimmering, and the lustre is metallic.

The fracture is even, sometimes inclining to flat conchoidal, and uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It becomes darker, and dull in the streak.
It soils.
It is soft.
It is brittle, and easily frangible.
Specific gravity, 4.407, *Karsten.*—4.073, *Vauquelin.*

Constituent Parts.

The four following analyses made by Cordier, Beaunier, Vauquelin, and Dolomieu, are said by Brochant to be of this kind.

	St Micaud.	Perigueux.	Romaneche.	Laveline.
Yellow Oxide of Manganese, - -	35	50.0	50.0	65
Oxygen, - -	33	17.0	33.7	17
Red Oxide of Iron,	18	13.5		
Charcoal, - -			0.4	
Lime, with Magnesia, Iron and Manganese,	7	6.0		
Carbonate of Lime, -				7
Barytes, - -	4	5.0	14.7	9
Silica, - - -	3	7.0	1.2	6
Loss, - - -		1.5		6
	100	100	100	100

Journal des Mines, N. 58. p. 778.

Geographic Situation.

It occurs at Upton Pyne in Devonshire; Wurzelberg in the Hartz; Nassau; and at Christiansand in Norway.

Fifth

Fifth Kind.

Earthy Grey Manganese-Ore.

Erdiches Grau Braunsteinerz, *Werner.*

Erdiger Braunstein, *Wid.* s. 953.—Ochre of Manganese, *Kirw.* vol. ii. p. 293.—Erdiches Graubraunsteinerz, *Emm.* b. ii. s. 529.—Le Manganese gris terreux, *Broch.* t. ii. p. 420.—Erdiches Graubraunsteinerz, *Lud.* b. i. s. 293. *Id. Suck.* 2ter th. s. 419. *Id. Bert.* s. 492. *Id. Mohs,* b. iii. s. 450.—Manganese terne terreux, *Brong.* t. ii. p. 110.—Zerreibliches Graubraunsteinerz, *Karsten,* Tabel. s. 72.—Ochriger Braunstein, *Haus.* s. 108.—Manganese oxydé noire brunâtre pulverulent et ramuleux, *Haüy.*—Erdiger grauer Braunstein, *Hoff.* b. iii. s. 148.

External Characters.

Its colour is intermediate between iron-black and steel-grey, sometimes slightly inclining to blue.

It occurs massive, disseminated, in membranes, and dendritic *.

It is friable.

It consists of feebly semi-metallic glimmering fine scaly particles, which soil strongly, and are more or less cohering.

Geographic Situation.

It occurs in the mine Johannis, near Langeberg in the Saxon Erzgebirge.

Chemical

* The dendritic appearances observed in the fissures of different minerals, appear in general to be earthy grey manganese-ore.

Chemical Characters of the Subspecies.

It is infusible without addition before the blowpipe. It tinges borax purple: it effervesces with muriatic acid, giving out oxymuriatic acid.

Geognostic Situation of the Subspecies.

This mineral occurs in granite, gneiss, mica-slate, porphyry, and sandstone, either in veins, or in large imbedded cotemporaneous masses. Several different formations are enumerated and described by mineralogists: in one formation, situated in porphyry, the ores which are principally the radiated and foliated kinds, occur in veins, along with heavy-spar; and in another, the ores, principally the compact and earthy kinds, are in veins, along with red and brown iron-ore.

Uses.

It is added to glass, in small quantity, when we wish to destroy the brown colour which that material receives from intermixed inflammable substances, or in larger quantity when we wish to give to it a violet-blue colour. It affords a fine brown colour, which is used for painting on porcelain. It is employed in the laboratory, as the cheapest and most convenient material from which to procure oxygen gas. All the oxymuriatic acid used in bleacheries, and for the purpose of destroying contagious matter, is prepared from manganese, and the usual materials of muriatic acid.

Second Subspecies.

Black Manganese-Ore.

This Subspecies is divided into three kinds, viz. Compact Black Manganese-ore, Fibrous Black Manganese-ore or Black Hematite, and Foliated Black Manganese-ore.

First Kind.

Compact Black Manganese-Ore.

Dichter Schwarzeisenstein, *Werner.*

Black Ironstone, *Kirw.* vol. ii. p. 167.—Mine de Fer noire compacte, *Broch.* t. ii. p. 268.—Dichter Schwarzeisenstein, *Reuss,* b. iv. s. 103. *Id. Mohs,* b. iii. s. 414. *Id. Leonhard,* Tabel. s. 66. *Id. Karsten,* Tabel. s. 66.—Dichter Manganschwärze, *Haus.* s. 109.—Black Hematitic Iron-ore, *Kid,* vol. ii. p. 176. Dichter Schwarzbraunstein, *Haus.* b. i. s. 294.—Dichter Schwarzeisenstein, *Hoff.* b. iii. s. 270.—Black Iron-ore, *Aikin,* p. 102.

External Characters.

Its colour is intermediate between bluish-black and dark steel-grey, but more inclining to the first.

It occurs massive, tuberose, small reniform, botryoidal, fruticose, and claviform; also in concentric curved lamellar concretions.

The external shapes have a rough glimmering, or faintly glistening surface.

Internally it is glimmering, passing into glistening, and the lustre is imperfect metallic.

The fracture is usually conchoidal, but sometimes passes into fine and small grained uneven.

 The

The fragments are indeterminate angular, and more or less sharp-edged.

The streak is shining, but its colour remains unchanged.

It is semi-hard.

It is brittle and easily frangible.

Specific gravity 4.750, *Ullmann*.

Second Kind.

Fibrous Black Manganese-Ore or Black Hematite.

Schwarzer Glaskopf, *Werner*.

Black Ironstone, *Kirw.* vol. ii. p. 167.—Mine de Fer noire compact, *Broch.* t. ii. p. 268.—Fasriger Schwarzeisenstein, *Reuss*, b. iv. s. 105. *Id. Mohs*, b. iii. s. 415. *Id. Leonhard*, Tabel. s. 66. *Id. Karsten*, Tabel. s. 66.—Fasriger Manganschwärze, *Haus.* s. 109.—Fasriger schwarz Braunstein, *Haus.* Handb. b. i. s. 293.—Fasriger Schwarzeisenstein, *Hoff.* b. iii. s. 273. Black Iron-ore, *Aikin*, p. 102.

External Characters.

Its colour is the same as that of the preceding kind.

It occurs massive, reniform, and botryoidal; also in distinct concretions, which are delicate and scopiform, or stellular fibrous, and these are collected into others which are granular and curved lamellar.

Internally it is glimmering, often even glistening, and the lustre is imperfect metallic.

The fragments are cuneiform and splintery.

In other characters it agrees with the preceding kind.

Chemical Characters.

When melted before the blowpipe with borax, it yields a violet-blue coloured glass.

Constituent Parts.

Its principal constituent part is manganese.

Geognostic Situation.

It occurs in veins, in primitive, transition, and secondary mountains, and is usually accompanied with brown iron-ore and quartz.

Geographic Situation.

It occurs in several places in the Saxon Erzgebirge, and the Hartz; but more frequently in Thuringia and Westphalia; and the compact and fibrous kinds generally occur together.

Uses.

It is very easily fusible, and yields a good iron; but it acts very powerfully on the sides of the furnace.

Third Kind.

Foliated Black Manganese-Ore.

Schwarzer Braunstein, *Werner.*

External Characters.

Its colour is brownish-black, and sometimes intermediate between brownish-black and reddish-black.

It occurs massive, disseminated; and crystallized in very acute double four-sided pyramids.

Externally it is shining; internally shining and glistening: and the lustre adamantine, approaching to resinous.

 Its

Its cleavage is single and curved foliated.

Its fragments are indeterminate angular, and rather blunt-edged.

It is opaque.

It affords a dark reddish-brown streak.

It is semi-hard, passing into hard.

It is rather brittle, and easily frangible.

Geognostic and Geographic Situations.

It occurs in veins in secondary porphyry, in the manganese formation of Oehrenstok, near Ilmenau in Thuringia.

Observations.

1. It resembles Black Blende and Wolfram: it is distinguished from *Black Blende* by its streak; and from *Wolfram* by inferior specific gravity.

2. It is conjectured to be a compound of oxide of manganese and oxide of iron.

Third Subspecies.

Scaly Brown Manganese-Ore.

Brauner Eisenrahm, *Werner.*

Id. Werner, Pabst. b. i. s. 159. *Id. Wid.* s. 814.—Brown scaly Iron-ore, *Kirw.* vol. ii. p. 166.—Brauner Eisenrahm, *Emm.* b. ii. s. 318.—Le Eisenrahm brun, *Broch.* t. ii. p. 258.—Brauner Eisenrahm, *Reuss,* b. iv. s. 90. *Id. Lud.* b. i. s. 247. *Id. Suck.* 2ter th. s. 270. *Id. Bert.* s. 409. *Id. Mohs,* b. iii. s. 391. *Id. Leonhard,* Tabel. s. 65.—Schuppiger Brauneisenstein, *Karsten,* Tabel. s. 66.—Manganese oxydé metalloide argentin, and probably also noire brunâtre, *Haüy.*—Brauneisenrahm, *Hoff.* b. iii. s. 251.—Scaly Brown Iron-ore, *Aikin,* p. 101.

External

External Characters.

Its colour is intermediate between steel-grey and clove-brown.

It occurs in crusts, massive, spumous, fruticose, and irregular dendritic.

It is friable, or friable passing into solid.

It is composed of scaly particles, which are intermediate between shining and glistening, with a metallic lustre.

It soils strongly.

It feels greasy.

Chemical Characters.

It blackens before the blowpipe, but does not melt, and gives to glass of borax an olive-green colour.

Geognostic Situation.

It generally occurs in drusy cavities in brown hematite. These cavities occur more frequently in hematite which is found in veins, than in that which is found in beds.

Geographic Situation.

Europe.—It is found near Sandlodge in Mainland, one of the Shetland Islands; and in various iron mines on the Continent of Europe.

America.—In iron mines in Chili.

Observations.

1. At Kamsdorf in Saxony, it is known under the names *Eisenmann* and *Eisenblüthe.*

2. The *Wad* of English mineralogists is a brown-coloured loose aggregated compound of oxides of manganese and iron.

ORDER III.

ORDER III.—*PYRITES.*

GENUS I.—NICKEL PYRITES, OR COPPER-NICKEL.

Nickelkies, *Mohs.*

This Genus contains one species, viz. Prismatic Nickel Pyrites. * Black Nickel. ** Nickel Ochre.

1. Prismatic Nickel Pyrites.

Prismatischer Nickelkies, *Mohs.*

Kupfer Nikel, *Werner.*

Niccolum Ferro et Cobalto mineralisatum; Cuprum Niccoli, *Wall.* t. ii. p. 188.—Kupfernickel, *Romé de Lisle,* t. iii. p. 135. *Id. Werner,* Pabst. b. i. s. 206. *Id. Wid.* s. 943.—Sulphurated Nickel, *Kirw.* vol. ii. p. 286.—Kupfernickel, *Emm.* b. ii. s. 513. *Id. Lam.* t. i. p. 384.—Nickel arsenical, *Haüy,* t. iii. p. 503.—Le Kupfernickel, *Broch.* t. ii. p. 408.—Kupfernickel, *Reuss,* b. iv. s. 430. *Id. Lud.* b. i. s. 289.—Nickelerz, *Suck.* 2ter th. s. 412.—Kupfernickel, *Bert.* s. 489. *Id. Mohs,* b. iii. s. 656.—Nickel arsenical, *Lucas,* p. 123.—Kupfernickel, *Leonhard,* Tabel. s. 77.—Nickel arsenical, *Brong.* t. ii. p. 209. *Id. Brard,* p. 468.—Kupfernickel, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 74.—Nickel arsenical, *Haüy,* Tabl. p. 84.—Nickel alloyed with Arsenic, *Kid,* vol. ii. p. 213.—Kupfernickel, *Hoff.* b. iii. s. 164. *Id. Haus.* Handb. b. i. s. 118.—Copper-Nickel, *Aikin,* p. 130.

External Characters.

Its colour is copper-red of different degrees of intensity; but tarnishes first grey, and then black.

It

It occurs most frequently massive and disseminated; seldom reticulated, dendritic, fruticose, small globular, botryoidal; rarely in coarse and small granular distinct concretions; and sometimes crystallised in oblique four-sided prisms.

Internally it alternates from shining to glistening, and the lustre is metallic.

The fracture is usually imperfect conchoidal, sometimes passing into coarse, small and fine grained uneven: The uneven has the least, the conchoidal the greatest degree of lustre.

The fragments are indeterminate angular and sharp-edged.

It is harder than apatite, but not so hard as felspar.

It is rather brittle.

It is rather difficultly frangible.

Specific gravity, 7.5—7.7 *Mohs*; 7.560, *Gellert*; 6.6086—6.6481, *Brisson*.

Chemical Characters.

Before the blowpipe it gives out an arsenical vapour, and then fuses, though not very readily, into a dark scoria, mixed with metallic grains; is soluble in nitro-muriatic acid, forming a dark-green liquor, from which caustic alkali throws down a pale-green precipitate, whereas from a solution of copper the precipitate is dark-brown.

Constituent Parts.

It is a compound of Nickel and Arsenic, with accidental intermixtures of cobalt, iron, and sulphur.

Geognostic

Geognostic Situation.

It generally occurs in primitive rocks, such as gneiss, mica-slate, syenite and clay-slate, along with octahedral or tin-white cobalt pyrites, and hexahedral or silver-white cobalt-pyrites; also in transition rocks and secondary rocks, particularly in limestone. The minerals with which it is most generally associated are nickel-ochre, octahedral and hexahedral cobalt pyrites, ores of copper, and of silver, along with calcareous-spar, brown-spar, heavy-spar, and quartz.

Geographic Situation.

Europe.—It occurs in small quantity in the lead-mines of Lead Hills and Wanlockhead; also in veins along with nickel-ochre, galena or lead-glance, brown-blende, and heavy-spar, in a bed of limestone in the coal field of Linlithgowshire. On the Continent, it occurs in veins in primitive rocks at Schneeberg and Johanngeorgenstadt in Saxony; at Joachimsthal in Bohemia; at Schladring in Upper Stiria; and Allemont in France. It is found in a bed along with native gold and cobalt-pyrites and copper-pyrites, in porphyritic syenite, at Cravicza in the Bannat. It is met with in veins that traverse transition rocks at Andreasberg in the Hartz. In the county of Mansfeldt, it occurs in veins that traverse bituminous marl-slate. It is also found at Wittichen in Swabia; Salzburg, and Gistain in Arragon in Spain.

Asia.—Koliwan in Siberia.

Observations.

1. It very nearly resembles native copper, but its brittleness very readily distinguishes it from that mineral.

2. Magnetic

2. Magnetic needles are made with the pure metal, and these are preferred to those of steel.

3. This mineral was first mentioned by Heärne, but it was Cronstedt who discovered the peculiar metal which characterises it.

4. Nickel is a characteristic ingredient in meteoric iron, and, like all the metals found in meteoric iron, and meteoric stones, is magnetical.

* Black Nickel.

Nickelschwärze, *Hausmann.*

Id. Haus. Handb. b. i. s. 331.

External Characters.

Its colour is dark greyish-black, which inclines to brownish-black.

It occurs massive, disseminated, and in crusts.

It is dull.

The fracture is earthy.

It is soft.

It becomes shining and resinous in the streak.

It soils slightly.

Chemical Characters.

It forms an apple-green coloured solution with nitric acid, which lets fall a white precipitate of arsenic acid.

Constituent Parts.

It has not been analysed; but is conjectured to be a compound of oxide of nickel and oxide of arsenic.

Geognostic

Geognostic and Geographic Situations.

It occurs in veins that traverse bituminous marl-slate, along with copper-nickel, and nickel-ochre, in the district of Riegelsdorf, particularly in the mine named Friedrich-Wilhelm *.

** Nickel-Ochre.

Nickelocker, *Werner.*

Flos Niccoli, *Wall.* t. ii. p. 300.—Nickelocker, *Werner,* Pabst. b. i. s. 207. *Id. Wid.* s. 945.—Nickel Ochre, *Kirw.* vol. ii. p. 283.—Oxide de Nikel, *De Born,* t. ii. p. 210.—Nickelocker, *Emm.* b. ii. s. 516.—Oxide de Nickel, *Lam.* t. i. p. 383. —Nickel oxidé, *Haüy,* t. iii. p. 516.—L'Ocre de Nikel, *Broch.* t. ii. p. 411.—Nickelocher, *Reuss,* b. iv. s. 435. *Id. Lud.* b. i. s. 290. *Id. Suck.* 2ter th. s. 414. *Id. Bert.* s. 496. *Id. Mohs,* b. iii. s. 661.—Nickel oxidé, *Lucas,* p. 123. *Id. Brard,* p. 278.—Nickelocker, *Leonhard,* Tabel. s. 77.—Nickel oxidé, *Brong.* t. ii. p. 209.—Nickelocher, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 112.—Nickel oxydé, *Haüy,* Tabl. p. 84.—Nickelblüthe, *Haus.* Handb. b. iii. s. 1129.—Native Oxyd of Nickel, *Kid,* vol. ii. p. 213.—Nickel Ochre, *Aikin,* p. 131.

External Characters.

Its colour is apple-green, seldom inclining to grass-green. On exposure to the air for some time, it becomes greenish-white.

It occurs almost always as a thin coating or efflorescence; seldom massive or disseminated.

It

* Hausmann is of opinion, that this ore is formed by the decomposition of copper-nickel.

It is dull.

The fracture is sometimes splintery, passing on the one side into even, on the other into uneven: or it is coarse or fine earthy.

The splintery and conchoidal varieties are translucent on the edges; but those with earthy fracture are opaque.

It is very soft or friable.

It feels meagre.

The varieties with earthy fracture adhere to the tongue.

Chemical Characters.

It is infusible without addition before the blowpipe; with glass of borax it is reduced, and the glass acquires a hyacinth-red colour; and it is insoluble in cold nitric acid.

Geognostic Situation.

It occurs in veins in primitive and secondary rocks, along with copper-nickel, black nickel, and other metalliferous compounds.

Geographic Situation.

It occurs at Lead Hills and Wanlockhead; at Alva in Stirlingshire, and in Linlithgowshire; at Andreasberg in the Hartz; Riegelsdorf in Saxony; and at Allemont in France.

Observations.

1. It occurs in very small quantities.

2. It is placed along with copper nickel until its true place in the system shall be ascertained.

Genus II.—ARSENICAL PYRITES.

Arsenikkies, *Werner*.

This Genus contains two species, viz. Prismatic Arsenical Pyrites, and Di-Prismatic Arsenical Pyrites.

1. Prismatic Arsenical Pyrites.

Prismatischer Arsenikkies, *Mohs*.

Fer sulphuré blanc, *Haüy*, (in part).

External Characters.

Its colour is pale steel-grey.

It occurs massive, and in the form of oblique four-sided prisms, whose dimensions have not been hitherto accurately determined.

Its lustre is metallic and shining.

Its cleavage is unknown.

It is as hard as apatite, but not so hard as felspar.

Specific gravity 6.9, 7.4, *Mohs*.

Observations.

The above description of this species I owe to Professor Mohs.

2. Di-prismatic Arsenical Pyrites.

Di-prismatischer Arsenikkies, *Mohs*.

This species contains two subspecies. Common Arsenical Pyrites, and Argentiferous Arsenical Pyrites.

First

First Subspecies.

Common Arsenical Pyrites.

Gemeiner Arsenikkies, *Werner.*

Id. Wern. Pabst. b. i. s. 212. *Id. Wid.* s. 968.—Arsenical Pyrites, or Marcasite, *Kirw.* vol. ii. p. 256.—Gemeiner Arsenikkies, *Emm.* b. ii. s. 553.—La Pyrite arsenicale commune, *Broch.* t. ii. p. 438.—Fer arsenical, *Haüy,* t. iv. p. 57.—Gemeiner Arsenikkies, *Reuss,* b. iv. s. 505. *Id. Lud.* b. i. s. 298. *Id. Suck.* 2ter th. s. 446. *Id. Bert.* s. 501. *Id. Mohs,* b. iii. s. 314.—Fer arsenical, *Lucas,* p. 138. *Id. Brard,* p. 314.—Gemeiner Arsenikkies, *Leonhard,* Tabel. s. 78. *Id. Karsten,* Tabel. s. 74. *Id. Haus.* s. 73.—Fer arsenical, *Haüy,* Tabl. p. 95.—Arsenic alloyed with Iron, *Kid,* vol. ii. p. 203.—Arsenikkies, *Haus.* Hand. b. i. s. 153. *Id. Hoff.* b. iv. s. 211. Mispickel, *Aikin,* p. 126.

External Characters.

On the fresh fracture it is silver-white, which rarely inclines to tin-white, but by exposure it acquires a yellowish tarnish; sometimes it has a pavonine, columbine, or iridescent tarnish, even in its natural repository.

It occurs massive, and disseminated; also in prismatic, distinct concretions, which are straight, diverging, or promiscuous, and these sometimes pass into granular.

It is frequently crystallized, and the primitive figure is an oblique four-sided prism, in which the large angle is 111° 18′. This oblique prism is generally bevelled on the terminal planes, and the bevelment is either flat or very flat. In this figure the bevelment is considered as an horizontal prism, and the oblique prism as a perpendicular prism, hence the figure is named Di-prismatic. The lateral planes are

are generally cylindrical concave. The following varieties of this form occur:

1. Bevelling planes rounded, so that the prism appears to have cylindrical convex terminal planes.
2. The angles between the acuter lateral edges and the bevelling planes truncated. When these increase in magnitude, a new and more acute bevelment is formed.
3. The angles of the edge of the bevelment truncated, and the truncating plane set on the obtuse lateral edges; when these planes increase in magnitude, there is formed,
4. A slightly oblique four-sided prism, acutely bevelled on the extremeties, and the bevelling planes set on the obtuse lateral edges, and the angles of the bevelling edges again truncated.
5. When the bevelling planes of the primitive prism approach very near to each other, there is formed a figure, which may be described as an acute broad double four-sided pyramid.

The crystals are middle-sized, small, and sometimes very small; they have smooth lateral planes, but the bevelling planes of the flat bevelment are usually diagonally ribbed.

Externally it is shining or splendent; internally it is shining, seldom glistening, and the lusture is metallic.

The fracture is coarse and small grained.

The cleavage is in the direction of the perpendicular prism.

The fragments are indeterminate angular, and rather blunt edged.

It is harder than apatite, and sometimes as hard as felspar.

It is brittle, and rather difficultly frangible.

When rubbed it emits an arsenical smell.

Specific gravity, 5.753, *Gellert*; 5.600, *Lametherie*; 5.7,—6.2, *Mohs.*

Chemical Characters.

Before the blowpipe it emits a copious arsenical vapour, which incrusts the charcoal white; and it leaves a reddish-brown oxide of iron behind. It colours borax blackish.

Constituent Parts.

Arsenic,	48.1	43.4	54.55
Iron,	36.5	34.9	45.46
Sulphur,	15.4	20.1	
	Thomson.	*Chevereul.*	*Berzelius.*

Geognostic Situation.

It occurs in beds and veins in primitive rocks, as gneiss, mica-slate, clay-slate, chlorite-slate, and serpentine. It is usually associated with tin, galena or lead-glance, blackblende, copper-pyrites and iron-pyrites, magnetic pyrites, and also quartz, brown-spar, fluor-spar, calcareous-spar, common hornblende, and garnet. It also occurs in transition-rocks, as grey-wacke, along with galena or lead-glance, grey copper-ore, sparry iron, and fluor-spar; and sometimes in secondary rocks.

Geographic Situation.

It occurs at Alva in Stirlingshire; and abundantly in Cornwall and Devonshire, accompanying ores of copper and

and tin. It occurs in beds in serpentine at Reichersdorf in Silesia; in beds at Kupferhügel, also in Silesia; at Gottesgab in Bohemia in beds in clay-slate, accompanied with tinstone, copper-pyrites, magnetic-pyrites, magnetic iron-ore, native silver, quartz, prase, garnet, and actynolite; at Joachimstahl in Bohemia, and Johanngeorgenstadt in Saxony in primitive mountains, along with tinstone, wolfram, galena or lead-glance, blende, sparry iron, and common iron-pyrites. It is also found at Kongsberg in Norway; Sahlberg in Sweden; in Salzburg, Stiria, Hungary and the Bannat.

Asia.—In Siberia, it is found along with beryl; it is also met with in China, and * in the island of Sumatra †.

America.—In granite, in the vicinity of Boston in Massachusets.

Use.

It is from this ore that the White Oxide of Arsenic is principally obtained, and artificial Orpiment is also prepared from it.

Observations.

1. Its crystallizations, colour, and hardness, distinguish it from *Tin-white Cobalt;* and its colour and specific gravity distinguish it from *Iron-pyrites.*

2. It is known under the names Mispickel, Rauschgelbkies, and Giftkies.

3. Some varieties contain so much gold, that they are named Auriferous Arsenical Pyrites, and are considered as ores of gold.

Second

* Marsden's Sumatra, p. 137.

Second Subspecies.

Argentiferous Arsenical Pyrites.

Weiserz, *Werner.*

Id. Werner, Pabst. b. i. s. 216. *Id. Wid.* s. 970.—Argentiferous Arsenical Pyrites, *Kirw.* vol. ii. p. 257.—Weiserz, *Emm.* b. ii. s. 557.—La Pyrite arsenical argentifere, *Broch.* t. ii. p. 442. —Fer arsenical argentifere, *Haüy,* t. iv. p. 63.—Weiserz, *Reuss,* b. iv. s. 503. *Id. Lud.* b. i. s. 299. *Id. Suck.* 2ter th. s. 449. *Id. Bert.* s. 503. *Id. Mohs,* b. iii. s. 321. *Id. Leonhard,* Tabel. s. 67.—Fer arsenical argentifere, *Brong.* t. ii. p. 150.—Edler Arsenikies, *Karsten,* Tabel. s. 74.—Weiserz, *Haus.* s. 73.—Fer arsenical argentifere, *Haüy,* Tabl. p. 96.—Argentiferous Mispickel, *Aikin,* p. 126.

External Characters.

Its colour is silver-white, inclining to tin-white, and is generally tarnished yellowish on the surface.

It seldom occurs massive, almost always disseminated, rarely in granular distinct concretions, and in very small acicular oblique four-sided prisms.

Externally it is shining; internally it is glistening, sometimes glimmering, and the lustre is metallic.

The fracture is fine-grained uneven.

The fragments are indeterminate angular.

In the remaining characters, it agrees with the preceding subspecies.

Constituent Parts.

Besides arsenic and iron, it contains from .01 to 0.10 parts of silver.

Geognostic and Geographic Situations.

Its geognostic situation is the same as that of common arsenic pyrites, with which it is usually associated. It is also accompanied with dark red silver, galena or lead-glance, and copper-pyrites; sometimes with white silver, brown blende, and generally with quartz and brown-spar.

It is a rare fossil, and has been hitherto found only at Braunsdorf and Freyberg in Saxony; Rathhausberg in Gastein in Salzburg; and in Chili.

Use.

It is used as an ore of silver.

Observations.

1. It is distinguished from the first subspecies by its inferior lustre, smallness of its crystals, fineness of the grain in the fracture, and its granular distinct concretions.

2. Hausmann describes as a distinct species, a sulphuret of iron, with 4 *per cent.* of arsenic. He names it *Arsenical kies*, and considers it as synonymous with the *Minera arsenicalis flavescens* of Wallerius. It is found at Goslar in the Hartz.

GENUS III.

Genus III.—COBALT-PYRITES

Kobalt-Kies, *Mohs.*

This genus contains two species, viz. Hexahedral Cobalt-Pyrites, and Octahedral Cobalt-Pyrites. * Kobalt-Kies, *Haus.*

1. Hexahedral Cobalt-Pyrites, or Silver-white Cobalt.

Hexaedrischer Kobalt-Kies, *Mohs.*

Glanz Kobold, *Werner.*

Minera Cobalti tessularis, *Wall.* Syst. Min. t. ii. p. 176.—Minera Cobalti crystallisata, *Wall.* Syst. Min. t. ii. p. 179. (in part). —Bright white Cobalt-ore, *Kirw.* vol. ii. p. 273.—Le Cobalt eclatant, *Broch.* t. ii. p. 390.—Cobalt gris, *Haüy*, t. iv. p. 204. —Kobaltglanz, *Lud.* b. i. s. 284. *Id. Suck.* 2ter th. s. 400. *Id. Bert.* s. 482. *Id. Mohs*, b. iii. s. 639. *Id. Leonhard*, Tabel. s. 76.—Cobalt gris, *Lucas*, p. 160. *Id. Brong.* t. ii. p. 116. *Id. Brard*, p. 354.—Glanzkobalt, *Karsten*, Tabel. s. 72.—Cobalt-glanz, *Haus.* s. 73.—Cobalt gris, *Haüy*, Tabl. p. 107.—Glanz Kobold, *Hoff.* b. iv. s. 186. *Id. Haus.* Handb. b. i. s. 157.—Bright-white Cobalt, *Aikin*, p. 128.

* Miners have been in all ages remarkable for their superstitious notions. The great mines in Germany were said to be haunted by evil spirits, named *Kobolden* by the miners; and those minerals having the appearance of rich ores, but which afforded nothing valuable, were considered as the work of these evil spirits, and were named *Kobold.* The different cobaltic minerals known to mineralogists, through the ignorance of the miners were thrown away as useless, and were named *Kobold*; hence the technical name *Cobalt.*

External Characters.

Its colour is silver-white, slightly inclining to copper-red. Sometimes it is tarnished yellowish or columbine.

It occurs commonly massive and disseminated; also reticulated, and occasionally in granular distinct concretions; and crystallized in the following figures:

1. Cube, which is either perfect, or truncated on the angles.
2. Octahedron.
3. Cube, in which all the edges are truncated, and in such a manner, that each face supports two opposite truncating planes: It is the middle figure, between the cube and the pentagonal dodecahedron.
4. Pentagonal dodecahedron.
5. Middle figure between the dodecahedron and the icosahedron.
6. Icosahedron.

The surface is smooth or streaked.

Externally it is splendent.

Internally it is intermediate between shining and glistening, and the lustre is metallic.

The cleavage is hexahedral.

The fracture is small conchoidal.

The fragments are indeterminate angular, and rather blunt-edged.

It is semihard in a low degree.

It is brittle and easily frangible.

Its streak is of a grey colour.

Specific gravity, 6.1—6.3, *Mohs*; 6.198, *Lowry*; 6.2319, *Strohmeyer*.

Chemical

Chemical Character.

Before the blowpipe it gives out an arsenical odour; and after being roasted, colours glass of borax smalt-blue.

Constituent Parts.

	Tunnaberg.	Tunnaberg.		Modum.
Cobalt, -	44.00		36.66	33.1012
Arsenic, - -	55.00		49.00	43.4644
Sulphur, -	0.50	Iron,	6.50	3.2324
	——	Sulphur,	5.66	20.0840
	99.50		——	————
	Klaproth, Beit. b. ii. s. 307.	*Tassaert* in Anal d. Chim. xxviii. p. 82.		*Strohmeyer.*

Geognostic Situation.

It occurs in primitive rocks, particularly in a quartzose mica-slate, and in gneiss, in imbedded masses, intermixed with the rock at their line of junction; also disseminated, and in imbedded crystals. It is associated with copper-pyrites, iron-pyrites, and red cobalt.

Geographic Situation.

It occurs principally at Skutterend in the parish of Modum, in Norway; at Tunnaberg in Sweden; and in small quantity at Queerbach in Silesia.

Uses.

This is one of the most common species of cobalt, and is that from which the cobalt of commerce is principally obtained.

tained. When roasted and melted in certain proportions with pounded quartze and potash, it forms *smalt*, a compound which is highly useful in the painting of porcelain, and in the colouring of glass, and also for painting.

The other kinds of cobalt are employed for similar purposes.

Observations.

1. This species is distinguished by its silver-white colour, crystallisations, distinct cleavage, hardness and weight.

2. It is distinguished from the octahedral species by its colour, its wanting the pentagonal, dodecahedral and octahedral figure; further, by its distinct cleavage and specific gravity.

3. It very nearly agrees with common iron-pyrites in form; hence Hausmann and others are of opinion that the form is owing to the combined sulphuret of iron.

2. Octahedral Cobalt-Pyrites.

Octaedrischer Cobalt-Kies, *Mohs*.

This species is divided into two subspecies, viz. Tin-White Octahedral Cobalt-Pyrites, and Grey Octahedral Cobalt-Pyrites. * Kobalt-Kies.

First Subspecies.

Tin-White Octahedral Cobalt-Pyrics.

Weisser Speisskobold, *Werner*.

This subspecies is divided into two kinds, viz. Compact Tin-White Cobalt-Pyrites, and Radiated Tin-White Cobalt-Pyrites.

First

First Kind.

Compact Tin-White Octahedral Cobalt-Pyrites.

Gemeiner Weisser Speisskobold, *Werner.*
Cobalt Arsenical, (greatest part), *Haüy.*

External Characters.

Its colour is tin-white, which is sometimes rather dark. It has frequently a grey and iridescent tarnish.

It occurs massive, disseminated, cylindrical, reticulated, fruticose, and specular; also in distinct concretions, which are small angular, granular, or curved lamellar.

It is sometimes crystallised, and the following are its various regular figures:

1. Cube, in which the faces are sometimes convex; the edges and angles are sometimes more or less deeply truncated. This figure is frequently cracked and burst in different directions.
2. Octahedron.
3. Rhomboidal dodecahedron, truncated on the six four-edged angles.

The crystals are from middle sized to small, are superimposed, and generally in druses.

It is characteristic of this subspecies, that the crystals are generally rent and cracked, and the rents frequently filled with quartz, and sometimes the crystals contain a nucleus of copper-nickel.

Externally it is generally smooth, shining or splendent, and the lustre metallic.

Internally

Internally it is glistening and metallic.

The cleavage is a very imperfect and octahedral.

The fracture is coarse and small-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is brittle and easily frangible.

Hardness same as the preceding species.

Specific gravity 6.0, 6.6, *Mohs*.

Constituent Parts.

	From Riegelsdorf.
Arsenic, - -	74.2174
Cobalt, - -	20.3135
Iron, - -	3.4257
Copper, - -	0.1586
Sulphur, - -	0.8860
	100

Strohmeyer.

The Saxon varieties contain a small portion of silver as an accidental mixed part.

Chemical Characters.

Before the blowpipe it gives out a copious arsenical vapour on the first impression of the heat; it melts only partially, and that with great difficulty, and is not attractable by the magnet; on the addition of borax it immediately melts into a grey metallic globule, colouring the borax of a deep blue.

Geognostic Situation.

This, which is the most frequent cobaltic species, occurs in veins and beds of granite, gneiss, mica-slate, and clay-slate;

slate; seldomer in transition clay-slate and limestone; but more frequently in flœtz rocks, as red sandstone and bituminous marl-slate. In primitive rocks, it is associated with copper-nickel, nickel ochre, native bismuth, bismuth-glance, black cobalt, ores of silver, and fluor-spar, calcareous-spar, brown-spar, lamellar heavy-spar and quartz; in transition rocks it is accompanied with copper-pyrites and quartz; in flœtz rocks with the various cobalt minerals, different ores of copper, calcareous-spar and lamellar heavy-spar.

Geographic Situation.

It occurs at Huel Sparnon, Redruth and Dolcoath in Cornwall; at Schneeberg, Annaberg and Johanngeorgenstadt in Saxony; Joachimsthal in Bohemia; Thuringia; Hessia; Stiria; Crawitza in the Bannat.

Observations.

This mineral is distinguished from *Grey Cobalt* by its colour, crystallisations, fracture and hardness; from *Silver-white Cobalt* by its silver-white colour, and very imperfect cleavage, and also by its crystallisations; in this mineral the predominating forms being the rhomboidal dodecahedron and cube, whereas the pentagonal dodecahedron and icosahedron are the characteristic forms of silver-white cobalt.

Second

Second Kind.

Radiated Tin-White Octahedral Cobalt-Pyrites.

Strahliger Weisser Speisskobold, *Werner.*

External Characters.

Its colour is tin-white, but generally very dark and inclining to grey.

It occurs massive, disseminated, and reniform; also in distinct concretions, which are scopiform and stellular radiated, sometimes passing into fibrous.

Internally it is glistening and metallic.

The fracture is uneven.

The fragments are indeterminate angular or wedge-shaped and splintery.

It is softer than the compact kind.

Other characters as in the preceding kind.

Constituent Parts.

Arsenic, - -	65.75
Cobalt, - -	28.00
Oxide of Iron, -	5.00
Oxide of Manganese, -	1.25
	100 *John.*

Geognostic and Geographic Situations.

It occurs rarely in veins in clay-slate at Schneeberg: Wallerius mentions, in the following terms, a mineral found near Kongsberg in Norway, which may be a variety of

of this cobalt: " Minera cobalti crystallisata, figura globosa, stricta."

Second Subspecies.

Grey Octahedral Cobalt-Pyrites.

Grauer Speisskobold, *Werner.*

Grauer Speisskobalt, *Lud.* b. i. s. 284. *Id. Mohs,* b. iii. s. 644. *Id. Leonhard,* Tabel. s. 76. *Id. Karsten,* Tabel. s. 72.—Speisskobalt, *Haus.* s. 75. (in part.)—Cobalt arsenical amorphe, *Haüy.*—Arsenical Cobalt, *Aikin,* p. 128.

External Characters.

On the fresh fracture its colour is light steel-grey, which sometimes inclines to whitish lead-grey; but by exposure it gradually acquires a tempered-steel or greyish-black tarnish.

It occurs massive, disseminated, tubiform, and specular.

Externally it is generally dull and tarnished.

Internally strongly glimmering or glistening, and the lustre is metallic; but the specular variety is splendent.

The fracture is even, which sometimes passes into flat and large conchoidal, sometimes into fine-grained uneven.

The fragments are indeterminate angular, and pretty sharp-edged.

It becomes shining in the streak, without change of colour.

In hardness agrees with the hexahedral cobalt-pyrites.

It is brittle and easily frangible.

When struck, emits an arsenical odour.

Specific gravity 6.135, *Breithaupt.*

Constituent

Constituent Parts.

According to Klaproth, it contains 19.60 parts of Cobalt, with Iron and Arsenic. Vid. *Klaproth* in d. Beob. u. Entd. b. i. s. 182.

Geognostic Situation.

It occurs in veins in granite, gneiss, mica-slate and clay-slate, associated with the tin-white octahedral cobalt-pyrites; but it is neither so frequent nor abundant.

Geographic Situation.

Europe.—It is found in Cornwall at Herland, along with native silver, in Huel Sparnon, near Redruth, along with bismuth, and in copper veins at Norway; Annaberg, Schneeberg, and Freyberg in the electorate of Saxony; Joachimsthal in Bohemia; Krobsdorf, Hindorf, and Kupferberg in Silesia; Wittichen in Swabia; Nassau; Salzburg; Allemont in France; Stiria; and Hungary.

America.—At Chatham in Connecticut, in North America, in hornblende rock.

Use.

Grey octahedral pyrites affords deeper and more beautiful blue colours than any of the other cobaltic minerals. From this circumstance it is named in Germany, *Fabriken-Kobold.*

Observations.

1. This mineral is characterised by its colour, fracture, hardness and weight. It is distinguished from *Grey Copper-ore* by fracture, greater weight and hardness, and its

want

want of crystallisations; from *Compact Grey Manganese-ore*, and *Compact Galena*, by its hardness; and from *Silver-white Cobalt-pyrites* by colour, form, fracture and weight.

Cobalt-kies, *Hausmann*.

Cobaltum pyriticosum, (ferro sulphurato mineralisatum), *Lin.* Syst. Nat. t. iii. p. 129.—Minera Cobalti sulphurea, *Waller.* Syst. Min. t. ii. p. 178.—Kobolt, med jern och suafelsyra, *Brandt*, in K. vet. Acad. Handl. 1746, p. 119.—Kobolt, med. forsvafladt jern, *Cronstedt*, Mineralogie, § 250,—Svafvelbunden Kobolt, *Hisinger*, in Afhandl. i Fysik, Kemi och Min. iii. 316.—Kobaltkies, *Haus.* Entw. s. 73. *Id. Haus.* Handb. b. i. s. 158.—Cobalt sulphuré, *Lucas*, t. ii. p. 516.

External Characters.

Its colour is pale steel-grey; which by tarnishing approaches to copper-red.

It occurs massive, disseminated, and it is said also crystallised in a cubical form.

Its lustre is shining and metallic.

Its fracture is uneven, passing into imperfect conchoidal, and sometimes shews an imperfect cleavage.

It is semihard.

Chemical Characters.

Before the blowpipe it emits a sulphureous odour, and after being roasted colours glass of borax smalt-blue.

Constituent

Constituent Parts.

Cobalt,	-	-	43.20
Sulphur,	-	-	38.50
Copper,	-	-	14.40
Iron,	-	-	3.53

Hisenger in Afhandl. i Physik.
Kemi och Min. iii. 321.

It is distinguished from the other pyritical cobalts by its want of arsenic.

Geognostic and Geographic Situations.

It occurs along with copper-pyrites, and common actynolite, in a bed in gneiss, at Naya Bastnas at Riddarhyttan, in Sweden.

Observations.

This mineral was well known to the older Swedish mineralogists; and Brandt, the discoverer of Cobalt, describes it in the Transactions of the Swedish Academy of Sciences, 8. B. s. 120. for 1746, German translation.

GENUS IV.—IRON PYRITES.

Eisen-Kies, *Mohs.*

This Genus contains three Species, viz. 1. Hexahedral Iron-Pyrites, 2. Prismatic Iron-Pyrites, and, 3. Rhomboidoidal Iron-Pyrites.

1. Hexahedral Iron-Pyrites, or Common Iron-Pyrites.

Hexaedrischer Eisen-Kies, *Mohs.*

Gemeiner Schwefelkies, *Werner.*

Pyrites colore aureo, *Plin.* Hist. Nat. xxxvi. (ed. Bip. v. 371.) *. —Sulphureus et Marcasita, *Waller.* Syst. Min. t. ii. p. 126. —Gemeiner Schwefelkies, *Werner,* Pabst. b. i. s. 130. *Id. Wid.* s. 794.—Common Sulphur Pyrites, *Kirw.* vol. ii. p. 76. —Gemeiner Schwefelkies, *Emm.* b. ii. s. 289.—Fer sulphuré, *Haüy,* t. iv. p. 65.–97.—La Pyrite martiale commune, *Broch.* t. ii. p. 221.—Gemeiner Schwefelkies, *Reuss,* b. iv. s. 14. *Id. Lud.* b. i. s. 236.—Eisenkies, *Suck.* 2ter th. s. 234.—Gemeiner Schwefelkies, *Bert.* s. 412. *Id. Mohs,* b. iii. s. 322. *Id. Hab.* s. 110.—Fer sulphuré, *Lucas,* p. 139.—Gemeiner Schwefelkies, *Leonhard,* Tabel. s. 62.—Fer sulphuré crystallisé, *Brong.* t. ii. p. 151.—Gemeiner Schwefelkies, *Karsten,* Tabel. s. 64. *Id. Haus.* s. 72.—Sulphuret of Iron, *Kid,* vol. ii. p. 184.—Fer sulphuré, *Haüy,* Tabl. p. 96. Schwefelkies, *Haus.* Handb. b. i. s. 146.—Gemeiner Schwefelkies, *Hoff.* b. iii. s. 191.—Common Pyrites, *Aikin,* p. 96.

External Characters.

Its colour is perfect bronze-yellow; sometimes tarnished, reddish, brownish, or with a brass-yellow colour.

It occurs most commonly massive, disseminated, globular, with impressions, and in membranes; also in granular distinct concretions, and frequently crystallised. Its crystallisations are as follows:

1. *Cube,*

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* The πυριμαχος or πυρομαχος of the Greeks is not our iron-pyrites, as is maintained by Henckel and Wallerius, but flint.—Vid. Beckmann, in his Notes to Aristot. lib. de Mirab. auscult. p. 96.

1. *Cube*, in which the faces are either straight, or spherical-convex or spherical-concave *, fig. 199. It is the most common crystallization of this species.
2. Cube, truncated on its edges, in such a manner that each truncation is more inclined towards one face than the other, and each face supports two opposite truncating planes †, fig. 200.
3. When the truncating planes of the preceding figure become so large that the original planes disappear, the *pentagonal dodecahedron* is formed ‡, fig. 201.
4. Cube truncated on all the angles ||, fig. 202.
5. When the truncations in the preceding figure become so large as to obliterate the original planes of the cube, an *octahedron* is formed §, fig. 203.
6. Octahedron bevelled on all the edges; the bevelment once broken, fig. 204.
7. Octahedron, in which the angles are accuminated with four planes, which are set on the lateral planes, and the summits of the truncations truncated, fig. 205.
8. Octahedron bevelled on all the angles ¶, fig. 206.
9. When the bevelling planes of the octahedron become large, the figure passes into the *icosahedron* **, fig. 207.

10. Cube,

* Fer sulphuré primitif, Haüy.

† Fer sulphuré cubo-dodecaedre, Haüy.

‡ Fer sulphuré dodecaedre, Haüy.

|| Fer sulphuré octaedre, Haüy.

¶ Fer sulphuré icosaedre, variet. *a*. Haüy.

** Fer sulphuré icosaedre, Haüy.

10. Cube, in which each angle is acuminated with three planes, which are set on the lateral edges *, fig. 208. Sometimes the acuminating planes become so large, that the original faces of the cube appear as small rhombs †, fig. 209.
11. Cube, in which each angle is acuminated with three planes, which are set on the lateral planes: sometimes the acuminating planes become so large, that the original faces of the cube entirely disappear, when there is formed
12. The *leucite crystallization*, or very acute double eight-sided pyramid, in which the lateral planes of the one are set on those of the other, and both extremities are acuminated with four planes, which are set on the alternate lateral edges ‡.

The cube alternates from large to small. The icosahedron and dodecahedron are in general only small.

The crystals are sometimes singly imbedded, or they occur in druses, or aggregated in balls and other forms.

It seldom occurs in supposititious crystals, which have been formed in crusts over pyramids of quartz, and tables of heavy-spar. Sometimes in extraneous external forms, particularly in ammonites, &c.

The surface of the crystals is sometimes smooth, sometimes alternately streaked, and the lustre extends from specular-splendent to glistening.

Internally it is usually shining and glistening, and the lustre is metallic.

The cleavage is hexahedral.

* Fer sulphuré quadriépointé, Haüy.

† Fer sulphuré tricontaedre, Haüy.

‡ Fer sulphuré trapezoidal, Haüy.

The fracture is coarse, small, or fine-grained uneven, and sometimes conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is harder than felspar, but not so hard as quartz.

It is brittle, and rather easily frangible.

When rubbed, or struck with steel, it emits a strong sulphureous smell.

Specific gravity,	4.7, 5.0,	*Mohs.*
Dodecahedral pyrites,	4.830,	*Hatchett.*
Pyrites in smooth-planed cubes,	4.831,	*Id.*
Pyrites from Cornwall,	4.789,	*Kirwan.*
Id. cubic pyrites,	4.7016,	*Brisson.*

Chemical Characters.

Before the blowpipe it emits a strong sulphureous odour, and burns with a bluish flame. It afterwards changes into a brownish-coloured globule, which is attractable by the magnet, and by continuance of the heat, passes into a blackish slag, which communicates a muddy-green colour to borax.

Constituent Parts.

	Dodecahedral Pyrites.	Pyrites in striated Cubes.	Pyrites in smooth Cubes.
Sulphur,	52.15	52.50	52.70
Iron,	47.85	57.50	47.30
	100	100	100

Hatchett, Phil. Trans. for 1804.

Some varieties, particularly those in striated cubes and dodecahedrons, contain a portion of gold, and hence have been named Auriferous Pyrites: other varieties contain silver.

Geognostic

Geognostic Situation.

It occurs in beds, in primitive, transition, and secondary mountains; also disseminated through various rocks, as granite, gneiss, mica-slate, clay-slate, primitive greenstone, porphyry, grey-wacke, sandstone, slate-clay, limestone, &c. In veins in primitive mountains, it is associated with galena or lead-glance, copper-pyrites, arsenical-pyrites, blende, frequently with native gold, seldomer with ores of silver: in transition mountains, with galena or lead-glance, blende, copper-pyrites, sparry iron, calcareous and fluor spar; and in secondary rocks, with ores of lead, copper, and zinc, and quartz, calcareous-spar, and fluor-spar. It is also disseminated in alluvial rocks, and in meteoric stones.

It is worthy of remark, that quartz is one of the most constant attendants of common iron-pyrites.

Geographic Situation.

This mineral is so universally distributed, that it is not necessary to enter here into any geographical details in regard to it.

Uses.

It is never worked as an ore of iron; it is principally valued on account of the sulphur which can be obtained from it by sublimation, and the iron-vitriol which it affords by exposure to the air, either with or without previous roasting. It was formerly cut into ornaments, but they are now out of use; and at one period it was used in place of flint in gun-locks.

Observations.

1. It is distinguished from *Pale-yellow Native Gold*, by its brittleness, the gold being malleable: from *Copper-pyrites*, by colour, crystallisation, fracture, and hardness: from *Arsenical pyrites*, by colour.

2. Some varieties on exposure are gradually changed into a brown ironstone; others are converted into sulphat of iron.

3. Iron-pyrites sometimes contains gold, silver, and copper; and it is remarked, that these metals generally occur in the striated cubes, the pentagonal dodecahedron, and the intermediate varieties of form between the cube and the dodecahedron.

4. Marcasite, according to Henckel, is a word used by the Arabians to express any substance in an imperfectly metallic state, and not easily reduced, and he supposes it may be derived from the Hebrew word "*marach*," "flavescere." Apothecaries at one time applied this name to bismuth, antimony, and several other metals. Miners apply the name to the crystallised varieties of iron-pyrites.

5. Polished pieces of a yellow-coloured mineral have been found in the graves of the early inhabitants of Peru, and are known by the name *Piedra de los Incas.* All of them appear to be either large crystals of iron-pyrites, or massive pieces of the same mineral more or less polished, and which appear to have been used as mirrors.

6. The most complete treatise on the natural and economical history of Pyrites, is that of Henckel, of which an English translation was published in London in 1757.

7. It has been described under the following names: Marcasite, Cat-gold, Gold-pyrites, Vitriolic-pyrites, Pyrite, and Gesundheitstein.

2. Prismatic

2. Prismatic Iron-Pyrites.

Prismatischer Eisenkies, *Mohs.*

This species is divided into five subspecies, viz. Radiated-pyrites, Hepatic-pyrites, Cellular-pyrites, Spear-pyrites, and Cockscomb-pyrites.

First Subspecies.

Radiated Pyrites.

Strahlkies, *Werner.*

Globuli pyritacei, *Wall.* Syst. Min. t. ii. p. 129.—Strahlkies, *Werner,* Pabst. b. i. s. 136. *Id. Wid.* s. 797.—Striated Pyrites, *Kirw.* vol. ii. p. 78.—Strahlkies, *Emm.* b. ii. s. 293.—Fer sulphuré radié, *Haüy,* t. iv. p. 59.—La Pyrite rayonnée, *Broch.* t. ii. p. 225.—Strahlkies, *Reuss,* b. iv. s. 25. *Id. Lud.* b. i. s. 337. *Id. Mohs,* b. iii. s. 337. *Id. Hab.* s. 111. *Id. Leonhard,* Tabel. s. 63.—Fer sulphuré radié, *Brong.* t. ii. p. 152.—Strahliger Schwefelkies, *Karsten,* Tabel. s. 64. *Id. Haus.* s. 74.—Fer sulphuré aciculaire-radié, *Haüy,* Tabl. p. 97.—Fer sulphuré prismatique rhomboidal, *Bournon,* Cat. Min. p. 301.

External Characters.

Its colour is very pale bronze-yellow, which, in the pyramidal varieties, inclines to brass-yellow.

It has sometimes an iridescent and pavonine tarnish.

It occours massive, but most commonly dendritic, reniform, stalactitic, globular, botryoidal, fruticose, tuberose with impressions: also in thin diverging prismatic or radiated

diated concretions, which are sometimes collected into others having granular figures, and these are traversed by curved lamellar concretions. It is frequently crystallised.

Its primitive form is an oblique four-sided prism, in which the obtuse angle is 106° 36′. The following are the principal varieties of secondary form:

1. Oblique four-sided prism, flatly bevelled on the extremities, the bevelling planes set on the acute lateral edges, fig. 210.
2. The preceding figure, in which the edge formed by the meeting of the two bevelling planes is deeply truncated, fig. 211: sometimes the obtuse edges are deeply truncated, fig. 212.
3. N° 1. in which the angles formed by the meeting of the bevelling and lateral planes on the obtuse edges are truncated.
4. N° 1. bevelled on the acute lateral edges.
5. Broad wedge-shaped double four-sided pyramid, in which the smaller lateral faces are sometimes curved.

The crystals are usually small and very small; externally shining, and glistening inclining to glimmering.

The fracture is uneven.

The fragments are wedge-shaped.

It is harder than felspar, but not so hard as quartz.

It is brittle.

It is very easy frangible, and breaks more readily in the direction of the lamellar than in the direction of the granular concretions.

When rubbed, or struck with steel, it emits a sulphureous odour.

Specific

Specific gravity, 4.7, 5.0, *Mohs.* 4.775, *Hatchett.* 4.729, *Wiedeman.*

Constituent Parts.

Sulphur,	-	53.60	54.34
Iron,	-	46.40	45.66
		100	100

Hatchett, Phil. Trans. for 1804.

Geognostic Situation.

It is much rarer than common iron-pyrites; occurs principally in small variously shaped masses, in chalk, clay, &c. and in veins, which contain lead and silver ores.

Geographic Situation.

It is found in Cornwall, Isle of Sheppy, Kent, Derbyshire, and other places in England; Freyberg, Gersdorf, Schneeberg, Annaberg, Johanngeorgenstadt, in Saxony; Bohemia; Zellerfeld and Goslar in the Hartz; Arendal in Norway; the islands of Morn and Seeland in Denmark; Schlangenberg in Siberia.

Observations.

It decomposes more readily than common iron-pyrites, particularly when it is exposed to a varying temperature in damp places, and then its surface becomes covered with greyish-white capillary iron-vitriol. In other instances the sulphur is volatilised, and the mineral remains unaltered in form, but in the state of an oxide of iron, forming what Haüy calls *cristaux epigenes.*

" Mr

"Mr Proust is of opinion, that the pyrites which contain the smallest quantity of sulphur, are those which are most liable to vitriolisation; and, on the contrary, that those which contain the largest proportion, are the least affected by the air or weather. This opinion of the learned Professor, by no means accords with such observations as I have been able to make; for the cubic, dodecahedral, and other regularly crystallised pyrites, are liable to oxidisement, so as to become what are called Hepatic Iron-ores, but not to vitriolisation; whilst the radiated pyrites (at least those of this country) are by much the most subject to the latter effect: and therefore, as the results of the preceding analyses shew that the crystallised pyrites contain less sulphur than the radiated pyrites, I might be induced to adopt the contrary opinion. But I am inclined to attribute the effect of vitriolisation, observed in some of the pyrites, not so much to the proportion, as to the state of the sulphur in the compound; for I much suspect, that a predisposition to vitriolisation in these pyrites, is produced by a small portion of oxygen being previously combined with a part, or with the general mass of the sulphur, at the time of the original formation of these substances, so that the state of the sulphur is tending to that of oxide, and thus the accession of a farther addition of oxygen becomes facilitated."—*Hatchett*, Phil. Trans. 1804.

Second

Second Subspecies.

Hepatic or Liver-Pyrites

Leberkies, *Werner.*

Pyrites fuscus, *Wall.* t. ii. p. 133.—Pyrite hepatique, *Romé de Lisle,* t. iii. p. 265.—Leberkies, *Werner,* Pabst. b. i. s. 139. *Id. Wid.* s. 800.—Hepatic Pyrites, *Kirw.* vol. ii. p. 83.—Leberkies, *Emm.* b. ii. s. 298.—La Pyrite hepatique, *Broch.* t. ii. p. 228.—Leberkies, *Reuss,* b. iv. s. 20. *Id. Lud.* b. i. s. 238. *Id. Mohs,* b. iii. s. 349.—Graugelber Eisenkies, *Hab.* s. 112. Leberkies, *Leonhard,* Tabel. s. 63. *Id. Karsten,* Tabel. s. 64. Dichter Schwefelkies, *Haus.* s. 72.—Hepatic Pyrites, *Aikin,* p. 97.

External Characters.

Its colour is very pale brass-yellow, which inclines more or less to steel-grey.

It changes its colour on the fresh fracture, and becomes brown, or acquires a columbine tarnish.

It occurs massive, disseminated, globular, tuberose, reniform, stalactitic, with impressions, and straight and small cellular.

Internally it is usually glimmering, seldom approaching to glistening, and the lustre is metallic.

The fracture is even, which sometimes passes into small-grained uneven, sometimes into flat conchoidal.

The fragments are indeterminate angular, and sharp-edged.

Specific gravity, 4.834, *Karsten.*

Geognostic

* The name of the species is from the brown colour it exhibits on the fracture surface.

Geognostic Situation.

It occurs only in veins in primitive rocks, and is usually accompanied with red silver, native silver, galena or lead-glance, common pyrites, black and brown blende, sparry-iron, iron-ochre, seldomer with silver-white cobalt, red cobalt, cinnabar, and grey antimony-ore: the accompanying vein-stones are, quartz, heavy-spar, brown-spar, fluor-spar, and calcareous-spar.

Geographic Situation.

It is found in Derbyshire; Freyberg, Johanngeorgenstadt in Saxony; Wolfstein in the Palatinate; Salzburg; Goslar in the Hartz; Hungary; Transylvania; Bohemia; Iceland; Norway; Sweden; and Siberia.

Observations.

It is the Wasserkies of some authors.

Third Subspecies.

Cellular Pyrites.

Zellkies, *Werner.*

Zellkies, 2. Unterart, *Reuss,* b. iv. s. 34. *Id. Mohs,* b. iii. s. 347. *Id. Leonhard,* Tabel. s. 63. *Id. Karsten,* Tabel. s. 64.

External Characters.

The colour is bronze-yellow, which inclines very much to steel-grey, and slightly to green.

By exposure it acquires a grey tarnish.

It occurs massive, but most frequently cellular, and of this

this form it exhibits the hexagonal, polygonal, and indeterminate varieties.

The surface of the cells is drusy.

Internally it is strongly glimmering; seldom, and only when it passes into common pyrites, glistening.

The fracture is even and flat conchoidal, seldom passing into fine-grained uneven.

The fragments are indeterminate angular, and pretty sharp-edged.

In other characters it agrees with the foregoing subspecies.

Geognostic and Geographic Situations.

It occurs in veins at Johanngeorgenstadt in the kingdom of Saxony, where it is accompanied with hepatic pyrites, common pyrites, galena or lead-glance, sparry iron, iron-ochre, brown-spar, heavy-spar, fluor-spar, and quartz.

Observations.

It is the least liable to decomposition of all the subspecies of pyrites.

Fourth Subspecies.

Spear-Pyrites *.

Sparkies, *Werner.*

External Characters.

Its colour is intermediate between bronze-yellow and steel-grey.

It

* It is named *Spear-pyrites*, because the crystals are grouped in a spear-like form.

It rarely occurs massive, generally crystallised, and always in twin or triple crystals.

The crystals are small and superimposed.

Externally it is shining; internally glistening, and the lustre is metallic.

The fracture is uneven, or imperfect conchoidal.

In other characters agrees with the preceding subspecies.

Geognostic and Geographic Situations.

It occurs in veins in primitive rocks, but more frequently in newer rocks, associated with brown-coal. It is found in Bohemia and in Saxony.

Fifth Subspecies.

Cockscomb-Pyrites.

Kamkies, *Werner.*

Fer sulphuré (blanc) dentélé, *Haüy.*

External Characters.

Its colour is bronze-yellow, inclining to pale steel-grey. Externally it has a mixture, which approximates the colour to brass-yellow.

It rarely occurs massive, almost always crystallised, and in the form of flat double four-sided pyramids. These crystals are grouped in rows, and are attached together by their smaller lateral planes, so that the aggregate somewhat resembles the comb of a cock.

Externally it is generally smooth.

Internally it is shining, or glistening and metallic.

The fracture is small-grained uneven.

The

The fragments are indeterminate angular, and rather sharp-edged.

In other characters it agrees with the preceding.

Geognostic and Geographic Situations.

It occurs in Derbyshire, and in some mines in Saxony.

Observations.

It is particularly characterised by the mode of grouping of its crystals: and is readily distinguished from *Arsenical-Pyrites* by its colour; and from *Copper-Pyrites* by crystallization and hardness.

3. Rhomboidal Iron-Pyrites, or Magnetic Pyrites.

Magnetkies, *Werner*.

Id. Werner, Pabst. b. i. s. 144. *Id. Wid.* s. 792.—Magnetic Pyrites, *Kirw.* vol. ii. p. 79.—Magnet-kies, *Emm.* b. ii. s. 286. —La Pyrite magnetique, *Broch.* t. ii. p. 232.—Magnetkies, *Reuss,* b. iv. s. 35. *Id. Lud.* b. i. s. 239. *Id. Suck* 2ter th. s. 245. *Id. Bert.* s. 416. *Id. Mohs,* b. iii. s. 352. *Id. Hab.* s. 112. *Id. Leonhard,* Tabel. s. 63.—Fer sulphuré magnetique, *Brong.* t. ii. p. 155.—Fer sulphuré ferrifere, *Haüy,* Tabl. p. 98.—Magnetic Pyrites, *Aikin,* p. 96.

This species is divided into two subspecies, viz. Foliated Magnetic Pyrites, and Compact Magnetic Pyrites.

First

First Subspecies.

Foliated Magnetic Pyrites.

Blättricher Magnetkies, *Hausmann.*

Blättriger Magnetkies, *Karsten,* Tabel. s. 64. *Id. Leonhard,* Tabel. s. 63. *Id. Haus.* Handbuch. b. i. s. 145.

External Characters.

Its colour is intermediate between bronze-yellow and copper-red, and sometimes inclines to pinchbeck-brown.

It occurs massive, disseminated, in coarse granular concretions; and very rarely crystallised.

The primitive figure Mohs considers to be a rhomboid, the dimensions of which are still unknown. The following crystallisations, which also occur in this mineral, may be traced back to the rhomboidal form:

1. Regular six-sided prism; sometimes truncated on the lateral edges, sometimes on the terminal edges, and occasionally on the terminal angles.
2. Six-sided pyramid, truncated on the apex.

Internally it is splendent, and the lustre is metallic.

The cleavage is rhomboidal.

The fracture is small and imperfect conchoidal.

The fragments are indeterminate angular and blunt-edged.

It is brittle and easily frangible.

Some varieties are harder than calcareous-spar; others harder than fluor-spar.

Specific gravity 4.4, 4.6, *Mohs.*

Geognostic and Geographic Situations.

It occurs at Breitenbrunn in Saxony; and at Bodenmais in Bavaria, in beds in primitive mountains, along with common iron-pyrites, magnetical iron-ore and blende.

Observations.

1. It was formerly conjectured, that the iron in this species was less oxidised than that in common iron-pyrites, and in this way its magnetic property was accounted for. Mr Hatchett has shewn, however, that iron, when combined naturally or artificially with 36.50 or 37 of sulphur, is not only still capable of receiving the magnetic fluid, but is also rendered capable of retaining it, so as to become in every respect a permanent magnet; and the same, he thinks, may, in a great measure, be inferred respecting iron, which has been artificially combined with 45.50 *per cent.* of sulphur.

2. Mr Hatchett has also shewn that magnetic pyrites agrees in chemical properties with artificial sulphuret of iron or pyrites.

Second Subspecies.

Compact Magnetic Pyrites.

Dichter Magnetkies, *Hausmann.*

Gemeiner Magnetkies, *Karsten,* Tabel. s. 64.—Dichter Magnetkies, *Haus.* s. 73. *Id. Haus.* Handb. b. i. s. 144.

External Characters.

Its colour is intermediate between bronze-yellow and copper-

copper-red, and sometimes inclines to pinchbeck-brown. On exposure to the air, its lustre gradually disappears, and it acquires a brownish tarnish.

It occurs only massive and disseminated.

Internally it is shining and glistening, and the lustre is metallic.

The fracture is fine and coarse-grained uneven, which sometimes passes into imperfect conchoidal.

The fragments are indeterminate angular, and blunt-edged.

It affects the magnetic needle.

In other characters it agrees with foliated magnetic pyrites.

Chemical Characters.

Before the blowpipe it emits a feeble sulphureous smell, and melts easily into a greyish-black globule, attractable by the magnet.

Constituent Parts.

According to Hatchett, it contains in 100 parts,

Sulphur, - - -	36.50
Iron, - - -	63.50
	100

Geognostic Situation.

This mineral occurs principally in primitive mountains, in beds, in gneiss, mica-slate, and primitive limestone, associated with iron-pyrites, copper-pyrites, arsenical-pyrites, magnetic iron-ore, galena or lead-glance, blende, quartz, garnet, actynolite, common hornblende, and rare-

ly

ly with tinstone. It is also found, either massive or disseminated, in transition greenstone and clay-slate.

Geographic Situation.

Europe.—It occurs in the Criffle, Windy-Shoulder, and other hills in Galloway; and at the base of the mountain called Moel Elion in Caernarvonshire. On the Continent of Europe, it is met with at Gillebeck and Kongsberg in Norway; Andreasberg and Treseberg in the Hartz; Breitenbrun in the Saxon Erzgebirge; Kupferberg in Silesia; Bodenmais in Bavaria; and in the Muhlbachthal in Salzburg.

Asia.—In the mines of Catharinenburg in Siberia.

America.—Zacatecas in Mexico.

Uses.

It is used for the same purposes as common iron-pyrites.

Genus V.—COPPER-PYRITES.

This genus contains two species, viz. Octahedral Copper-Pyrites, and Tetrahedral Copper-Pyrites.

1. Octahedral Copper-Pyrites, or Yellow Copper

Octaedrischer Kupferkies, *Mohs*.

Kupferkies, *Werner*.

Minera Cupri flava, *Wall.* t. ii. p. 282.—Mine de Cuivre jaune, *Romé de Lisle,* t. iii. p. 309.—Kupferkies, *Werner,* Pabst. b. i. s. 75. *Id. Wid.* s. 746.—Copper-Pyrites or Yellow Copper-Ore, *Kirw.* vol. ii. p. 140.—Mine de Cuivre jaune, *De Born,* t. ii. p. 313.—Kupferkies, *Estner,* b. iii. s. 494. *Id. Emm.* b. ii. s. 232.—Cuivre pyriteux, *Lam.* t. i. p. 197.—La Pyrite cuivreux, *Broch.* t. ii. p. 169.—Kupferkies, *Reuss,* b. iii. s. 415. *Id. Lud.* b. i. s. 223. *Id. Suck.* 2ter th. s. 181. *Id. Bert.* s. 386. *Id. Mohs,* b. iii. s. 239. *Id. Hab.* s. 107.—Cuivre pyriteux, *Lucas,* p. 125.—Kupferkies, *Leonhard,* Tabel. s. 57. —Cuivre pyriteux, *Brong.* t. ii. p. 213. *Id. Brard,* p. 283.—Kupferkies, *Karsten,* Tabel. s. 62. *Id. Haus.* s. 71.—Yellow Sulphuret of Copper, *Kid,* vol. ii. p. 109.—Cuivre pyriteux, *Haüy,* Tabl. p. 85.—Kupferkies, *Haus.* Handb. b. i. s. 161. *Id. Hoff.* b. iii. s. 113.—Yellow Copper, *Aikin,* p. 87.

External Characters.

On the fresh fracture, its colour is brass-yellow, of different shades: the varieties richest in copper have a deep yellow colour, approaching to gold-yellow; the poorer varieties incline to greyish brass-yellow, and steel-grey.

It is usually tarnished, either with variegated colours, as pavonine, columbine, and sometimes tempered steel coloured, or with simple colours, as blue and black.

The tarnished colours occur sometimes on the mineral in

* Throughout the work, where the name *Copper-Pyrites* occurs, it is to be understood as applicable only to the *Octahedral* species.

in the bosom of the earth, sometimes on exposure of the recent fracture to the action of the air.

It occurs massive, disseminated, and in membranes; also dendritic, reniform, botryoidal, stalactitic, specular, amorphous; and crystallized as follows:

1. Regular Octahedron.
   a. Perfect.
   b. Truncated on all the edges.
   c. Truncated on all the angles.
   d. Truncated on all the edges and angles.
   e. Elongated.
   f. Edges bevelled.

Frequently four of the alternate planes of the octahedron become larger than the others, and thus there is at length formed a

2. Tetrahedron.
   a. Truncated on all the angles.
   b. Perfect.
   c. Tabular segment.

Frequently two segments of this description are attached by their bases, and thus form a *Twin*-crystal.

The crystals are usually small and very small, and generally superimposed.

Externally it is intermediate between glistening and shining, and is often splendent.

Internally it is shining, which in some varieties passes into glimmering, and the lustre is metallic.

The cleavage is probably octahedral.

The fracture is most commonly coarse and small-grained uneven: the coarse-grained passes into imperfect and small conchoidal: the small-grained passes into fine-grained uneven, also into even, and large and flat conchoidal. The lustre varies with the fracture; the highest degree of lus-

tre is in the small conchoidal: and the large conchoidal and even, have the least lustre, being only glimmering.

The fragments are indeterminate angular, and rather sharp-edged.

Some varieties are as hard as fluor-spar, others are not harder than calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, 4.1—4.2, *Mohs;* 4.160, *Gellert;* 4.080, *Kirwan.*

Chemical Characters.

Before the blowpipe, on charcoal, it decrepitates, emits a greenish-coloured sulphureous smoke, and melts into a black globule, which, by continuing the fire gradually, assumes the metallic lustre of copper. It imparts to borax a green tinge.

Constituent Parts.

	Cornwall.	St Bel.	Freyberg.
Copper,	30	30.0	32.0
Iron,	53	31.0	34.0
Sulphur,	12	36.5	33.0
	95	97.5	99.0
	Chenevix.	*Gueniveau.*	*Breithaupt.*

It sometimes also contains small portions of gold or silver.

Geognostic Situation.

It is one of the most abundant metalliferous minerals: it occurs in almost every kind of repository, and in all the great classes of rocks. Thus, it is met with in granite, gneiss,

gneiss, mica-slate, clay-slate, porphyry, syenite, trap, grey-wacke, in secondary limestones, in coal formations, and also in those of sandstone. In these rocks, it is associated with various metalliferous and earthy minerals, such as iron-pyrites, magnetic iron-ore, malachite, blue copper, tile-ore, red copper, variegated copper, copper-glance or vitreous copper, galena or lead-glance, blende, cobalt-ochre, arsenical pyrites, sparry iron, and sometimes native gold: the earthy minerals are calcareous-spar, fluor-spar, heavy-spar, brown-spar, quartz, garnet, actynolite, hornblende, tremolite, &c.

Geographic Situation.

Europe.—In veins that traverse a great bed of quartz in the Clifton mine, near Tyndrum in Perthshire; in these veins, it is associated with copper-green, red cobalt-ochre, galena or lead-glance, brown and yellow blende, quartz, and heavy-spar: in a vein in red sandstone in the Mainland, the largest of the Shetland Islands, where it is accompanied with grey copper, malachite, native copper, iron-pyrites, sparry iron, and brown iron-ore: at the mines of Ecton, on the borders of Derbyshire and Staffordshire, it is embedded in limestone, and is accompanied with galena or lead-glance, blende, calcareous-spar, fluor-spar, and heavy-spar: at Pary's Mountain in Anglesea, it occurs in a bed of great thickness, associated with native copper, malachite, blue copper, galena or lead-glance, and calamine: in several lead-mines in Derbyshire: abundantly in the copper-mines of Cornwall, along with copper-glance, grey copper and red copper. There are considerable copper-mines at Cronebane and Ballymurtagh, in the county of Wicklow in Ireland, and the principal ore

is

is copper-pyrites. This mineral is met with in considerable abundance on the Continent of Europe, but the localities are so numerous, that we cannot spare room but for a few of them. It occurs in the mines of Rörras and Arendal in Norway; in that of Fahlun in Sweden; in the Hartz; the Saxon Erzgebirge; Hessia, Bohemia, Franconia, Suabia, Bavaria, Silesia, Austria, Hungary, Spain, France and Russia.

Asia.—Siberia; and Japan.

America.—United States; Mexico; and Chili.

Africa.—Morocco; Abyssinia; country of the Namaquas, in Southern Africa.

Uses.

Nearly one-third of all the copper which is obtained by metallurgic operations, is extracted from this species: it is, however, a poor ore, seldom yielding above 36 pounds, more commonly only 20 pounds of copper in the hundred. Sulphur is frequently obtained from it by sublimation.

In Cornwall, the annual quantity of copper-ore raised, is sometimes 73.700 tons, of which the principal ore is yellow copper-pyrites. This quantity of ore affords 6.425 tons of pure copper, and sells for L. 410,936.

Observations.

1. It has been confounded with *Native Gold*, but it may be readily distinguished from that mineral by its fracture, which is uneven, imperfect conchoidal, or foliated; whereas that of gold is hackly; and also by its tenacity, it being brittle, whereas gold is malleable. It is distinguished from *Iron-pyrites* by its inferior hardness, it not exceeding fluor-spar hardness,

hardness, while iron-pyrites is harder than felspar; by colour, iron-pyrites being bronze-yellow, whereas it is brass-yellow; and the crystallizations are also very different from those of iron-pyrites; in particular, it occurs in tetrahedrons, a form never observed in iron-pyrites.

2. It passes into several other species of ore, particularly into White Copper, Grey Copper and Variegated Copper.

3. The softer varieties of copper-pyrites contain the greatest quantity of copper, and the harder the greatest proportion of iron. Among the softer varieties, those having a tarnished surface are said to contain the greatest quantity of copper.

4. Those varieties which contain the largest proportion of sulphur, are the least affected by exposure to the air.

2. Tetrahedral Copper-Pyrites.

Tetraedrischer, Kupferkies, *Mohs.*

This species is subdivided into two subspecies, viz. Grey Copper, and Black Copper.

First Subspecies.

Grey Copper.

Fahlerz, *Werner.*

Cuivre gris arsenifère, *Haüy.*

Minera Cupri grisea, *Wall.* t. ii. p. 281.—Mine d'Argent grise, et Mine de Cuivre grise, *Romé de Lisle,* t. iii. p. 315.—Fahlerz, *Wern.* Pabst. b. i. s. 83. *Id. Wid.* s. 751.—Grey Copper-ore,

ore, *Kirw.* vol. ii. p. 146.—Fahlerz, *Estner,* b. iii. s. 509. *Id. Emm.* b. iii. s. 238.—Argent gris, *Lam.* t. i. p. 138.—Mine d'une couleur fauve, ou le Cuivre gris, ou le Fahlerz, *Broch.* t. ii. p. 175.—Cuivre gris, *Haüy,* t. iii. p. 536,–556.—Fahlerz, *Reuss,* b. iv. s. 198. *Id Lud.* b. i. s. 224. *Id. Mohs,* b. iii. s. 231. *Id. Hab.* s. 108.—Cuivre gris, *Lucas,* p. 126.—Fahlerz, *Leonhard,* Tabel. s. 58.—Cuivre gris arsenié, *Brong.* t. ii. p. 215. *Id. Brard,* p. 286.—Fahlerz, *Karsten,* Tabel. s. 62. *Id. Haus.* s. 74.—Grey Copper-ore, *Kid,* vol. ii. p. 115.—Cuivre gris, *Haüy,* Tabl. p. 86.—Kupferfahlerz, *Haus.* Hand. b. i. s. 164.—Fahlerz, *Hoff.* b. iii. s. 119.—Grey Copper, *Aikin,* p. 86.

External Characters.

Its colour is steel-grey, which sometimes inclines to iron-black and lead-grey.

It occurs rarely with a tempered-steel coloured tarnish.

It occurs massive, disseminated, seldom in membranes, and often also crystallized: its crystallizations are the following:

1. Tetrahedron, or simple three-sided pyramid *, Pl. 11. fig. 213, which presents the following varieties:
   - *a.* Truncated on the angles †, fig. 214; or on the edges ‡, Pl. 11. fig. 215.
   - *b.* Bevelled on the edges ||, Pl. 11. fig. 216. When the bevelling edges increase so much as to cause the original planes of the tetrahedron to disappear, a tetrahedron is formed, in which each plane is divided into three, or there is formed on

* Cuivre gris primitif, Haüy.

† Cuivre gris epointé, Haüy.

‡ Cuivre gris cubo-tetraedre, Haüy.

|| Cuivre encadré, Haüy.

on each of the planes a very obtuse acumination *, Pl. 11. fig. 217.

c. Each of the angles of the tetrahedron very flatly acuminated with three planes, Pl. 11. fig. 218: sometimes the edges of the tetrahedron are bevelled at the same time †, and also the summits and edges of the acuminations ‡. When the acuminating planes increase so much that the original faces of the tetrahedron disappear, there is formed,

2. The rhomboidal or great dodecahedron, Pl. 11. fig. 219.

The crystals are small and seldom middle-sized; usually singly superimposed, or in druses.

Their surface is shining and splendent.

Internally it is usually glistening; sometimes, however, it passes into shining, and has a metallic lustre.

The fracture is coarse and small-grained uneven; sometimes it inclines to imperfect conchoidal, and such varieties have a blackish colour, the strongest lustre, and contain the greatest proportion of silver, and the least of copper.

The fragments are indeterminate angular, and rather blunt-edged.

Some varieties are harder than calcareous-spar, others harder than fluor-spar, but none so hard as apatite.

It generally remains unaltered in the streak; some afford a reddish-brown streak ||.

It

* Cuivre gris dodecaedre, Haüy.

† Cuivre gris apophane, Haüy; Cuivre gris progressif, Haüy.

‡ Cuivre gris identique, Haüy.

|| According to Count de Bournon, those varieties that afford a reddish-brown streak, may be presumed to contain a mixture of silver and antimony, generally combined together in the state of red silver-ore.

It is brittle, and easily frangible.

Specific gravity, 4.4—4.9, *Mohs*. 4.594, *Wiedemann*. 4.8648, *Hauy*. 4.4460 to 4.560, *Bournon*.

Chemical Characters.

Before the blowpipe, it first decrepitates, and then melts into a greyish-coloured brittle metallic globule. During fusion it disengages a white aresenical vapour: to borax it communicates a yellowish colour inclining to red. Some varieties are difficult of fusion.

Constituent Parts.

From Airthrie.	
Copper,	19.2
Iron,	51.0
Sulphur,	14.1
Arsenic,	15.7
	160.00
Thomson, Ed. Tran.	

	Freyberg.	Freyberg.	Freyberg.
Copper,	41.00	48.00	42.50
Iron,	22.50	25.50	27.60
Sulphur,	10.00	10.00	10.00
Arsenic,	24.10	14.00	15.60
Silver,	0.40	0.50	0.90
Antimony,		-	1.50
	98.00	98.00	98.00
	Klaproth, Beit. b. iv. s. 47.	Ib. s. 49.	Ib. s. 52.

Some varieties contain Gold, as that of Hohenstein: others, as that of Guadalcanal in Spain, from 1 to 10 *per cent.* of Platina.

Geognostic Situation.

It occurs in beds and veins, in primitive, transition, and secondary rocks, in which it is usually accompanied with copper-pyrites, galena or lead-glance, ores of manganese, sparry iron, heavy-spar, calcareous-spar, fluor-spar, and quartz; seldomer with malachite, blue copper, and other cupreous minerals.

Geographic

Geographic Situation.

Europe.—It occurs along with copper-pyrites in red sandstone, near Sandlodge, in the Mainland of Shetland; in small veins at Fassney Burn in East Lothian; at Airthrie, in the Ochill Hills, north-east of Stirling, in veins along with heavy-spar, and calcareous-spar; also in Ayrshire; at Tavistock in Devonshire; in the copper-mines of Cornwall; at Kongsberg in Norway, along with variegated copper; at Freyberg in Saxony, in veins that traverse gneiss, along with copper-pyrites, sparry iron, quartz, calcareous-spar, heavy-spar, and fluor-spar; in the Hartz, also with copper-pyrites, and sparry iron, in veins that traverse greywacke, and transition clay-slate; in flœtz limestone at Falkenstein in the Tyrol; at Saint Marie-aux-Mines in France; at Baigorry, in Navarre, in Spain; in veins in gneiss, at Hochberg in the dukedom of Baden; in porphyry at Gablan in Silesia; in Thuringia, along with red and brown cobalt-ochre, and heavy-spar; at Saska and Oravicza, in the Bannat in Hungary; also at Kremnitz, and other parts in that kingdom; at Kapnic, Nagyag, and Offenbanya, in Transylvania; and in the government of Olonetz in Russia.

Asia.—Kolywan; Tobolsk, along with copper-green; and in several of the mines in the Uralian Mountains.

America.—In the mines of Guanaxuato in Mexico, in veins, along with copper-pyrites, brown-spar, calcareous-spar, amethyst, hornstone, and calcedony; and also in the mines of Zimapan, with quartz, calcareous-spar, and gypsum; and in the copper-mines of Chili.

Uses.

Uses.

It is valued as an ore of copper; and when it contains silver, it is worked as an ore of that metal.

Observations.

1. It passes into Copper-pyrites, and Copper-glance or Vitreous Copper.

2. Colour, tetrahedral form, hardness, brittleness, and specific gravity, are its essential characters. It is distinguished from *Octahedral Copper-pyrites*, by its colour, hardness, and brittleness; and this last character distinguishes it from *Brittle Silver*, and *White Silver*.

Second Subspecies.

Black Copper.

Schwarzerz, *Werner*.

Cuivre gris arsenifère, *Haüy*.

Minera Cupri grisea, (in part) *Waller*. Syst. Min. t. ii. p. 281.—Cuivre gris, (in part), *Haüy*, t. iii. p. 357.—Graugiltigerz, *Reuss*, b. ii. 3. s. 427.—Schwartzgiltigerz, *Lud.* b. i. s. 218. *Id. Suck.* 2ter th. s. 185. *Id. Bert.* s. 398. *Id. Mohs*, b. iii. s. 196.—Graugiltigerz, *Leonhard*, Tabel. s. 58.—Cuivre gris antimonié, *Brong.* t. ii. p. 216.—Graugiltigerz, *Karsten*, Tabel. s. 62.—Schwarzgiltigerz, *Haus.* s. 74.—Cuivre gris arsenifere, *Haüy*, Tabl. p. 87—Schwarzgiltigerz, *Haus.* Handb. b. i. s. 166.—Schwarzerz, *Hoff.* b. iii. s. 127.—Antimonial Grey Copper, *Aikin*, p. 86.

External

External Characters.

Its colour is iron-black, which sometimes inclines to steel-grey.

It occurs massive, disseminated; and crystallised in the following figures:

1. Tetrahedron.
   a. Perfect.
   b. Bevelled on the edges, and the angles flatly acuminated with three planes, which are set on the lateral planes.
   c. The preceding figure, in which the summits of the acuminations are truncated.
2. When the acuminations on the angles of the tetrahedron become so large that its original planes disappear, then a rhomboidal or garnet dodecahedron is formed.

The crystals are generally splendent, and are often invested with a thin crust of copper-pyrites.

Internally it is shining and splendent, and the lustre is metallic.

The fracture is small and imperfect conchoidal.

Same hardness as grey copper.

It is brittle, and very easily frangible.

Specific gravity 4.842, 4.893, *Ullmann.*

Chemical Characters.

Before the blowpipe, it decrepitates, and then melts into a black cupreous bead, giving out a white antimonial vapour.

Constituent Parts.

	Kapnik in Transylvania.	Poratsch in Hungary.	Annaberg in Saxony.	Zilla in Clausthal.	St Wenzel near Wolfach.	Peru.
Copper,	37.75	39.00	40.25	37.50	25.50	27.00
Antimony,	22.00	19.50	23.00	29.00	27.00	23.50
Sulphur,	28.00	26.00	18.50	21.50	25.50	27.75
Silver,	0.25		0.30	3.00	13.25	10.25
Iron,	3.25	7.50	13.50	6.50		
Lead,	-	-		-	-	1.75
Arsenic,	-		0.75			
Zinc,	5.00					
Mercury,	-	6.25				
Loss,	3.75	1.75	3.70	2.50	1.75	2.75
	100.00	100.00	100.00	100.00	100.00	100.00

Klaproth, Beit. b. iv. s. 56. 68. 73. & 80.

From these analyses, it appears, that the essential component parts of Black Copper are, Copper, Antimony, Iron, and Sulphur, and that the Silver, Lead, Zinc, and Mercury, are only accidentally mixed.

Geognostic and Geographic Situations.

Europe.—It occurs in veins that traverse transition rocks at Zilla, in the Clausthal in the Hartz *; Annaberg in Saxony; in the mine of St Wenzel, at Wolfach in the Schwarzwald; at Kapnik, in red manganese; at Nagyag, along with iron-pyrites, grey copper, and quartz; at Kremnitz and Poratsch in Hungary; and Allemont in Dauphiny.

America.—In Peru, in veins in alpine limestone.

Use.

It is worked, both as an ore of copper and as an ore of silver.

* The crystals found at Zilla, are generally invested with a crust of copper-pyrites.

Observations.

1. It has been confounded with *Grey Copper*, but it may be distinguished from it by its iron-black colour, splendent lustre, and small conchoidal fracture.

2. It is intermediate between Brittle Silver-glance and Grey Copper.

3. It is the most compounded of all the ores of copper.

* White Copper.

Weiss Kupfererz, *Werner*.

Weisslich Kies-kupfererz, *Henkel's* Kieshistorie, s. 210.—Minera Cupri alba, *Wall.* t. ii. p. 280.—Weiss Kupfererz, *Werner*, Pabst. b. i. s. 83. *Id. Wid.* s. 750.—White Copper-ore, *Kirw.* vol. ii. p. 152.—Weiss Kupfererz, *Estner*, b. iii. s. 500. *Id. Emm.* b. ii. s. 236.—Mine de Cuivre blanche arsenicale, *Lam.* t. i. p. 201.—La Mine de Cuivre blanche, *Broch.* t. ii. p. 173.—Weiss Kupfererz, *Reuss*, b. iii. s. 425. *Id. Lud.* b. i. s. 224. *Id. Suck.* 2ter th. s. 184. *Id. Bert.* s. 397. *Id. Leonhard,* Tabel. s. 58. *Id. Karsten,* Tabel. s. 62. *Id. Haus.* s. 74.—Weiss Kupfererz, *Haus.* Handb. b. i. s. 159. *Id. Hoff.* b. i. s. 131.—White Copper, *Aikin,* p. 87.

External Characters.

Its colour is intermediate between silver-white and brass-yellow. On the fresh fracture, it soon becomes tarnished with a greyish-yellow colour.

It occurs massive and disseminated.

Internally it is glistening, with a metallic lustre.

The fracture is small and fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It

It is semi-hard.

It is brittle, and easily frangible.

Specific gravity 4.500, *La Metherie.*

Chemical Characters.

Before the blowpipe, it yields a white arsenical vapour, and melts into a greyish-black slag.

Constituent Parts.

Henkel, who gave the first account of this ore, informs us, that it contains 40 parts of Copper, and the remainder consists of Iron, Arsenic, and Sulphur.

Geognostic Situation.

It occurs in veins and mineral beds in primitive and transition rocks. It is usually accompanied with copper-pyrites, and copper-glance or vitreous copper-ore, seldomer with grey copper, copper-green, red copper, blue copper, and native silver.

Geographic Situation.

Europe.—In the mine called Huel Gorland in Cornwall; in the mines Lorenz Gegentrum and Elias, near Freyberg in the kingdom of Saxony; Rudelstadt, Altenberg, and Kupferberg in Silesia; Lauterberg in the Hartz; Frankenberg in Hessia; Christophsthal, near Freüdenstadt in Wurtemberg; Strazena, behind the Creutzberg in Upper Hungary.

Asia.—Catharinenburg in Siberia.

America.—Chili.

Observations.

1. It has been frequently confounded with Copper-pyrites, Copper-glance, Grey Copper, and Arsenical-pyrites. It is, however, easily distinguished from *Copper-pyrites*, *Copper-glance*, and *Grey Copper*, by its colour; and from *Arsenical-pyrites* by its inferior specific gravity.

2. It is an intermediate species between copper-pyrites and arsenical-pyrites.

Genus VI.—TIN-PYRITES *.

This genus contains one species, viz. Common Tin-Pyrites.

1. Common Tin-Pyrites.

Zinnkies, *Werner*.

Id. Wid. s. 875.—Tin-pyrites, *Kirw.* vol. ii. p. 200.—Zinnkies, *Emm.* b. ii. s. 418.—Etain sulphuré, *Lam.* t. i. p. 279. *Id. Haüy*, t. iv. p. 154.—La Pyrite d'Etain, ou l'Etain pyriteux, *Broch.* t. ii. p. 332.—Zinnkies, *Reuss*, b. iv. s. 286. *Id. Lud.* b. i. s. 267. *Id. Suck.* 2ter th. s. 354. *Id. Bert.* s. 440. *Id. Mohs*, b. iii. s. 591.—Etain sulphuré, *Lucas*, p. 151.—Zinnkies, *Leonhard*, Tabel. s. 75.—Etain pyriteux, *Brong.* t. ii. p. 191.—Etain sulphuré, or Mussif natif, *Brard*, p. 337.—Zinnkies, *Karsten*, Tabel. s. 70. *Id. Haus.* s. 74.—Etain sulphuré,

* Although this mineral is placed here for the present as a distinct species, we should not be surprised to find that it is a mixture of Sulphurets of Copper and Iron, with mechanically diffused Tin.

sulphuré, *Haüy*, Tabl. p. 102.—Sulphuret of Tin, *Kid*, vol. ii. p. 154.—Zinnkies, *Haus*. Handb. b. i. s. 161. *Id. Hoff*. b. iv. s. 51.—Tin-Pyrites, *Aikin*, p. 117.

External Characters.

Its colour is intermediate between steel-grey and brass-yellow, but usually more inclined to the first.

It occurs massive and disseminated.

Internally it is glistening, sometimes shining, and the lustre is metallic.

The fracture is small and coarse-grained uneven; sometimes inclining to small and imperfect conchoidal.

The fragments are indeterminate angular and blunt-edged.

It yields easily to the knife.

It is brittle and easily frangible.

Specific gravity, 4.350, *Klaproth*.

It is not magnetic.

Chemical Characters.

Before the blowpipe it exhales a sulphureous odour, and melts easily, without being reduced, into a black scoria.

It communicates a yellow or green colour to borax.

Constituent Parts.

Tin, -	34	26.50
Copper, -	36	30.00
Iron, -	3	12.00
Sulphur,	25	30.50
Earthy Matter,	2	
	100	99
	Klaproth, Beit. b. ii. s. 257.—264.	*Klaproth*, Beit. b. v. s. 230.

Geognostic

Geognostic and Geographic Situations.

It has been hitherto found only in Cornwall, as at St Agnes, Stenna Gwynn, Huel Rock, and Huel Scorier, associated with ores of copper and blende, and in small veins in granite at St Michael's Mount.

Observations.

Its colour and greater hardness distinguish it from *Copper-Pyrites:* inferior hardness, and different colour and weight, from *Iron-Pyrites;* and inferior specific gravity and colour distinguish it from *Grey Copper.*

ORDER IV. *GLANCE.*

GENUS I.—COPPER-GLANCE, OR VITREOUS COPPER.

Kupfer-Glanz, *Mohs.*

This genus contains one species, viz. Rhomboidal Copper-Glance. * Variegated Copper.

1. Rhomboidal Copper-Glance, or Vitreous Copper-Ore.

Kupferglas, *Werner.*

This species is divided into two subspecies, viz. Compact Copper-Glance, and Foliated Copper-Glance.

First Subspecies.

Compact Copper-Glance, or Compact Vitreous Copper-Ore.

Dichtes Kupferglas, *Werner.*

Cuprum vitreum, *Wall.* Syst. Min. vol. ii. p. 277.—Dichtes Kupferglas, *Wern.* Pabst. b. i. s. 71.—Compact Vitreous Copper-ore, *Kirw.*. vol. ii. p. 144.—Dichtes Kupferglanzerz, *Estner,* b. iii. s. 476.—Kupferglas, *Emm.* b. ii. s. 223.—Cuivre sulphuré, *Haüy,* t. iii. p. 551.–555.—Le Cuivre vitreux compacte, *Broch.* t. ii. p. 162.—Dichter Kupferglanz, *Reuss,* b. iii. s. 401. *Id. Lud.* b. i. s. 220. *Id. Suck.* 2ter th. s. 173. *Id. Berl.* s. 383. *Id. Mohs,* b. iii. s. 253. *Id. Leonhard,* Tabel. s. 57.—Cuivre sulphuré, *Brong.* t. ii. p. 212. *Id. Brard,* p. 289.—Gemeiner Kupferglanz, *Karsten,* Tabel. s. 62.

s. 62. *Id. Haus.* s. 71.—Grey Sulphuret of Copper, *Kid,* vol. ii. p. 106.—Cuivre sulphuré, *Haüy,* Tabl. p. 87.—Dichter Kupferglanz, *Haus.* Handb. b. i. s. 142. *Id. Hoff.* b. iii. s. 104.—Glance Copper, *Aikin,* p. 84.

External Characters.

Its colour is blackish lead-grey, which sometimes inclines to steel-grey, and to iron-black, and has often a tempered-steel coloured tarnish.

It occurs massive, disseminated, in plates, membranes; and sometimes crystallised.

Its primitive form is a rhomboid, whose dimensions are unknown. The following are some of its secondary figures:

1. Low equiangular six-sided prism, which is sometimes so short as to form a six-sided table.
2. Preceding figure, in which the alternate angles are truncated.
3. Prism in which the terminal edges are truncated, and the truncating planes are inclined to the lateral planes under an angle of 151° 52′.
4. Prism truncated as in the preceding, but in which the truncating planes are inclined to the lateral planes, under an angle of 121° 37′.
5. Double six-sided pyramid; two varieties; one formed from the truncations of fig. 3. and another from the truncation of fig. 4.

The crystals are small and very small, seldom middle-sized.

Externally it is shining.

Internally it is intermediate between shining and glistening, and sometimes even passes into glimmering: it is most commonly glistening, and the lustre is metallic.

The

The fracture is small and fine-grained uneven, which passes into small conchoidal; also into large and flat conchoidal, and sometimes into even.

The fragments are indeterminate angular, and more or less sharp-edged.

It retains its colour, and is shining in the streak.

It is harder than gypsum, and sometimes as hard as calcareous-spar.

It is perfectly sectile.

It is rather easily frangible.

Specific gravity 5.5,—5.8, *Mohs.*

Constituent Parts.

	Siberia.		Rothenburg.
Copper, -	78.05		76.50
Iron, - -	2.25		0.50
Sulphur, -	18.50		22.00
Silica, -	0.75	Loss,	1.00
	100.00		100.00
	Klaproth, Beit. b. ii. s. 279.		Ibid. b. iv. s. 39.

Second Subspecies.

Foliated Copper-Glance, or Foliated Vitreous Copper-Ore.

Blättriches Kupferglanz, *Werner.*

Id. Werner, Pabst. b. i. s. 73.—Foliated Vitreous Copper-ore, *Kirw.* vol. ii. p. 146.—Blättriges Kupferglanzerz, *Estner,* b. iii. s. 477.—Blättriges Kupferglas, *Emm.* b. ii. s. 225.—Le Cuivre

Cuivre vitreux lamelleux, *Broch.* t. ii. p. 164.—Blättriches Kupferglanz, *Reuss,* b. iii. s. 403. *Id. Lud.* b. i. s. 222. *Id. Suck.* 2ter th. s. 178. *Id. Bert.* s. 385. *Id. Mohs,* b. ii. s. 260. *Id. Leonhard,* Tabel. s. 57.—Schuppiger Kupferglanz, *Karsten,* Tabel. s. 62.—Cuivre sulphuré feuilleté, *Haüy. Id. Haus.* s. 72.—Blättricher Kupferglanz, *Haus.* Handb. b. i. s. 142.—Blattriges, Kupferglas, *Hoff.* b. iii. s. 109.

External Characters.

Its colour is the same as that of the preceding subspecies.

It occurs massive, disseminated, in granular concretions, and very rarely crystallised, in the same figure as the compact subspecies.

Internally it is shining, which sometimes passes to splendent, sometimes to glistening, and the lustre is metallic.

The cleavage is not very distinct; one cleavage is parallel with the terminal planes, and other three with the truncations on the alternate angles of the prism.

The fragments are indeterminate angular, and blunt-edged.

In the remaining characters, it agrees with the preceding subspecies.

Chemical Characters of the Species.

Before the blowpipe, on charcoal, it melts very easily, and yields a globule of copper, covered with a blackish-coloured scoria. When melted with borax, it communicates to it a green colour; and when digested with ammonia, it tinges it blue.

Constituent

Constituent Parts.

Copper, - -	79.50
Sulphur, - -	19.00
Iron, - -	0.75
Quartz, - -	1.00
	100.25
	Ullmann.

Geognostic Situation.

It occurs in veins and beds in primitive rocks; also in beds in bituminous marl-slate, and in flœtz amygdaloid. The accompanying minerals in the primitive and transition rocks, are copper-pyrites, grey copper, blue copper, malachite, copper-green, and red and brown iron ores, with calcareous-spar, and quartz; in the flœtz rocks, it is associated with copper-pyrites, and variegated copper.

Geographic Situation.

Europe.—It occurs in small veins, along with heavy-spar, in transition rocks, at Fassney Burn in East Lothian; also in Ayrshire; and in the Fair Isle, situated between Orkney and Shetland; at Middleton Tyas in Yorkshire; Llandidno in Caernarvonshire; Cook's Kitchen, Carvath, Tincroft, Camborne, Huel-Muttrel, and Bullen Garden, in Cornwall: in the mines of Friedrichsminde and Glittersberg in Norway, along with quartz, malachite, variegated copper, &c.; also in the mines of Kongsberg; at Atwod and Sunnerskog in Sweden; in Hessia, along with grey copper, white copper, malachite, brown iron-ore, tile-ore, variegated copper, copper-pyrites, sparry iron, white cobalt, quartz, and calcareous-spar;

spar; in Thuringia, in bituminous marl-slate, associated with copper-pyrites, and variegated copper; in different mines in the Saxon Erzgebirge, where it is accompanied with various ores of copper, iron, and silver; thus, at Berggieshübel, it occurs along with copper-pyrites, iron-pyrites, compact and ochry red iron-ore, native silver, and lamellar heavy-spar; and at Deutschneudorf, with quartz, lithomarge, ochry red iron-ore, and copper-green; at Graupen in Bohemia, with grey copper and copper-green: in talc-slate in Moravia: in amygdaloid in Deux-Ponts: at Schwaz in the Tyrol, along with fibrous malachite, slaggy ironshot copper-green, and blue copper; in the Leogang, and Limberg in Bavaria: in Silesia; in the Kinzegthal in Suabia, along with copper-green, malachite, and quartz, in veins that traverse gneiss: Catalonia in Spain: in primitive limestone at Saska, in the Bannat of Temeswar; and in Hungary.

Asia.—In great abundance in different mines in the Uralian Mountains.

America.—In small quantities, along with copper-green and quartz, in West Greenland.

Observations.

1. Compact and Foliated Copper-glance are sometimes confounded with *Grey Copper*, but may be readily distinguished from it, by their being sectile, whereas grey copper is brittle. The red colour and red-coloured streak of *Red Copper*, distinguish it at once from copper-glance; and *Silver-glance* or *Sulphureted Silver*, although somewhat resembling the two subspecies of copper-glance in external aspect, yet may be readily distinguished from them by an obvious character, viz. Its cutting readily into

to slices with a knife, whereas these minerals separate into small grains when we attempt to cut them.

2. The tarnished varieties of Compact and Foliated Copper-glance incline to Variegated Copper.

3. The Frankenberg or Hessian corn-ears mentioned by authors, are sometimes aggregations of small crystals of copper-glance; sometimes, according to M. Monch, true petrifactions of a phalaris, (Phalaris pulposa ?), composed of copper-glance, white copper and grey copper. They are sometimes invested with a thin cover of native silver.

4. It is rather a rare mineral, and the only country in which it has been met with in great quantity, is Siberia.

* Variegated Copper.

Buntkupfererz, *Werner*.

Cuprum lazureum, *Wall.* t. ii. p. 278.—Bunt Kupfererz, *Werner*, Pabst. b. i. s. 73. *Id. Wid.* s. 744.—Cuivre sulphuré violet, *De Born*, t. ii. p. 311.—Purple Copper-ore, *Kirw.* vol. ii. p. 142.—Bunt Kupfererz, *Estner*, b. iii. s. 489. *Id. Emm.* b. ii. s. 228.—La Mine de Cuivre panachée ou violette, *Broch.* t. ii. p. 166.—Cuivre pyriteux hepatique, *Haüy*, t. iii. p. 536. —Buntkupfererz, *Reuss*, b. iii. s. 410. *Id. Lud.* b. i. s. 222. *Id. Suck.* 2ter th. s. 179. *Id. Bert.* s. 385. *Id. Mohs*, b. iii. s. 248. *Id. Leonhard*, Tabel. s. 57.—Le Cuivre pyriteux panaché, *Brong.* t. ii. p. 215.—Bunt Kupfererz, *Karsten*, Tabel. s. 62. *Id. Haus.* s. 74.—Variegated or Iridescent Sulphuret of Copper, *Kid*, vol. ii. p. 108.—Cuivre pyriteux hepatique, *Haüy*, Tabl. p. 86.—Bunt Kupfererz, *Haus.* Handb., b. i. s. 163. *Id. Hoff.* b. iii. s. 110.—Purple Copper, *Aikin*, p. 85.

External Characters.

Its fresh colour is intermediate between copper-red and pinchbeck-brown; it, however, soon acquires a tarnish, which

which is first reddish, then the red passes successively into violet-blue, azure-blue, and sky-blue, and lastly into green; yet several of these colours are to be observed on the same mass, so that it has a variegated aspect, and of these colours the blue is usually the predominant, and the green occurs only in spots.

It occurs massive, disseminated, in plates, in membranes; and crystallised in six-sided prisms.

Internally it is shining or glistening, and the lustre is metallic.

The fracture is small and rather imperfect conchoidal, which sometimes approaches to fine-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

Neither colour nor lustre are changed in the streak.

It is soft.

It is sectile in a slight degree.

It is easy frangible.

Specific gravity, from the Bannat, 4,956, *Kirwan*. From Lorraine, 4.983, *Kirwan*. 5.051, *Breithaupt*. 5.467, *Wiedenman*. 5.033, *Bournon*.

Chemical Characters.

It is fusible, but not so easily as copper-glance, and with less ebullition, into a globule, which acts powerfully on the magnetic needle.

Constituent Parts.

	From Hitterdahl in Norway.	From Rudelstadt in Silesia.
Copper, -	69.50	58
Sulphur, -	19.00	19
Iron, - -	7.50	18
Oxygen, -	4.00	5
	100.0	100
	Klaproth, Beit. b. ii. s. 283.	Ibid. s. 286.

Geognostic

Geognostic Situation.

It occurs in veins in primitive and transition rocks, particularly in gneiss, mica-slate, talc-slate, and grey-wacke. It is also met with in flœtz rocks, as in beds in bituminous marl-slate. In these repositories, it is associated with grey copper, copper-pyrites, copper-glance or vitreous copper-ore, copper-green, malachite, iron-pyrites, blende, brown iron-ore, quartz, common garnet, heavy-spar, calcareous-spar, tremolite, and actynolite.

Geographic Situation.

Europe.—It is found in Cook's Kitchen and Tincroft mines in Cornwall, along with grey copper, copper-pyrites, &c.; in the mines of Arendal in Norway, where it is associated with copper-glançe or vitreous copper, copper-pyrites, and common garnets; in beds in gneiss at Kongsberg, also in Norway, along with native silver; at Lauterberg in the Hartz, in veins that traverse grey-wacke, along with copper-pyrites, and tile-ore; and in the Fluss Mine, in the same country, along with fluor-spar, lamellar heavy-spar, calcareous-spar, and blue copper; in the Saxon Erzgebirge, along with grey-copper, copper-glance, copper-pyrites, and different ores of silver; in bituminous marl-slate in Mansfield and Thuringia; at Kupferberg in Silesia, in a metalliferous bed, along with copper-pyrites, blue copper, malachite, tile-ore, copper-glance or vitreous copper-ore, arsenical-pyrites, iron-pyrites, lamellar heavy-spar, brown-spar, calcareous-spar, and heavy-spar; at Olonez in Russian Finland, with iron-pyrites, copper-pyrites, copper-green, and quartz; at Swappawari in Lapland, in quartz and mica-slate; in Transylvania, along with amethyst; at Dognatska, with common garnet, blende, copper-

copper-pyrites, copper-green, and malachite, in calcareous-spar or quartz; and at Oravicza, along with calcareous-spar and asbestous tremolite.

Asia.—At Schlangenberg, along with quartz, brown-spar, and hornstone; and in the Pochadjaschinche mines, associated with malachite, blue copper, and quartz.

America.—At Coquimbo in Chili, along with copper-green and malachite.

Uses.

Copper is extracted from it, but is not so easily reduced as copper-glance. It yields from 50 to 70 *per cent.* of copper.

Observations.

1. Its external characters and chemical composition, shew that it is intimately connected with copper-glance.

2. It occurs equally abundant with copper-glance, but not in such great quantity as copper-pyrites.

3. This variety differs from copper-glance or vitreous copper-ore, with respect to its component parts, in containing a smaller proportion of copper, and a greater proportion of Iron. The variegated colour is supposed by Klaproth to be owing to the slightly oxidated state of the metal: so in steel, and other metallic substances, the beginning of their oxidation is indicated by a similar diversity of colours. In the last-mentioned substances, indeed, the change of colour is only superficial, for the oxygen of the atmosphere can only act upon the surface of the metal: in the variegated copper-ore, the diversity of colour penetrates the whole mass, in consequence of the general distribution of the oxygen throughout the substance of the ore. As, however, the oxidation is slight, the

the metal is disposed to absorb a farther portion of oxygen; and the uniform brown colour is gradually produced in consequence, as often as a fresh surface is exposed to the action of the air *.

4. It was formerly confounded with Copper-glance, Copper-pyrites, and Red Copper; but Werner ascertained it to be a distinct species, and gave it its present name from its tarnish, which is one of the most striking features in its external aspect.

GENUS II.—SILVER-GLANCE, OR VITREOUS SILVER.

Silber-Glanz, *Mohs.*

This genus contains two species, viz. Hexahedral Silver-Glance, and Rhomboidal Silver-Glance. * White Silver. ** Grey Silver.

1. Hexahedral Silver-Glance.

Hexaedrischer Silber-Glanz, *Mohs.*

This species is subdivided into two subspecies, viz. Compact Hexahedral Silver-Glance, and Earthy Hexahedral Silver-Glance.

* Kid's Min. vol. ii. p. 108, 109.

First Subspecies.

Compact Hexahedral Silver-Glance, or Compact Vitreous Silver.

Dichtes Glanzerz, *Hausmann.*

Minera Argenti vitrea, *Wall.* t. ii. p. 329.—Mine d'Argent vitreuse, *Romé de Lisle,* t. iii. p. 440.—Argent vitreuse, *De Born,* t. ii. p. 424.—Glaserz, *Werner,* Pabst. b. i. s. 33. *Id. Wid.* s. 696.—Sulphurated Silver-ore, *Kirw.* vol. ii. p. 115. —Geschmeidiges Silberglanzerz, *Estner,* b. iii. s. 370.—Glaserz, *Emm.* b. ii. s. 175.—Argent vitreuse, *Lam.* t. i. p. 120. *Id. Broch.* t. ii. p. 134.—Argent sulphuré, *Haüy,* t. iii. p. 398. -402.—Glanzerz, *Reuss,* b. iii. s. 342. *Id. Lud.* b. i. s. 214. *Id. Suck.* 2ter th. s. 142. *Id. Bert.* s. 366. *Id. Mohs,* b. iii. s. 144.—Geschmeidiges Silber-glanzerz, *Hab.* s. 103.—Argent sulphuré, *Lucas,* p. 105.—Glanzerz, *Leonhard,* Tabel. s. 54.—Argent sulphuré, *Brong.* t. ii. p. 251. *Id. Brard,* p. 245.—Glanzerz, *Karsten,* Tabel. s. 60.—Dichtes Glanzerz, *Haus.* s. 71.—Sulphuret of Silver, *Kid,* vol. ii. p. 87.—Argent sulphuré, *Haüy,* Tabl. p. 74.—Dichtes Glanzerz, *Haus.* Handb. b. i. s. 137.—Glaserz, *Hoff.* b. iii. s. 57.—Sulphureted Silver, *Aikin,* p. 77.

External Characters.

The colour is dark blackish lead-grey. On exposure, its surface acquires a pavonine or tempered-steel coloured tarnish.

It generally occurs massive, sometimes disseminated, and in membranes, but seldom in plates; also in several particular external shapes, as dentiform, filiform, capillary, reticulated, irregular dendritic, stalactitic, with globular

bular and pyramidal impressions, corroded and amorphous; also crystallised. Its crystallisations are the following:

1. Cube, which is either perfect or truncated on its edges or angles, or on both at the same time *.
2. Octahedron †. It is either perfect or truncated on its angles or edges. When the edges of the common basis are very deeply truncated, it passes into the rectangular four-sided prism, acuminated on both extremities by four planes, which are set on the lateral planes.
3. Rhomboidal dodecahedron, which is formed from the cube or the octahedron, by the truncation of their edges ‡. Its edges are sometimes truncated.
4. Double eight-sided pyramid, flatly acuminated on both extremities by four planes, which are set on the alternate lateral edges.

The last mentioned crystallisation is rare.

The crystals are seldom middle-sized; usually small and very small; superimposed, or aggregated in rows. The octahedron is generally aggregated in rows, the other crystallisations usually superimposed. The cubes are sometimes hollow.

The surface of the crystals is sometimes smooth, sometimes drusy. The particular external shapes, which frequently terminate in crystals, have a streaked surface.

Externally it is shining and glistening, and when drusy, faintly glimmering.

Internally

* Argent sulphuré cubique; Argent sulphuré cubo-octaedre, Haüy.

† Argent sulphuré octaedre, Haüy.

‡ Argent sulphuré dodecaedre, Haüy.

Internally it alternates from shining to glistening, and the lustre is metallic.

The cleavage is rhomboidal.

The fracture is commonly small-grained uneven; sometimes it inclines to imperfect small and flat conchoidal.

The fragments are indeterminate angular, and blunt-edged.

Its lustre is increased in the streak.

It is harder than gypsum, but not so hard as calcareous-spar.

It is completely malleable.

It is flexible, but not elastic.

It is difficultly frangible.

Specific gravity 5.7,—6.1, *Mohs.*

Chemical Characters.

Before the blowpipe it loses its sulphur, and a bead of pure silver remains. If heated gently in a furnace, the sulphur dissipates, and the silver appears in its metallic state, in dendritic and capillary forms, resembling some varieties of native silver.

Constituent Parts.

	From Himmelsfürst.	From Joachimsthal.		
Silver, -	85	84.81	84	75
Sulphur, -	15	14.19	16	25
	100	99.00	100	100
	Klaproth.	*Klaproth.*	*Sage,*	*Bergman.*

Geognostic Situation.

It is one of the most frequent of the ores of silver, and there are few formations of that metal which do not contain

tain it. It occurs principally in veins that traverse primitive and transition rocks, such as gneiss, mica-slate, clay-slate, and grey-wacke; less frequently in porphyry; and still seldomer in granite. In these veins, it is associated with various ores of silver, copper, and lead, and also of iron, zinc, cobalt, arsenic, and more rarely with native gold. Of the accompanying earthy minerals, the following may be enumerated, viz. quartz, calcareous-spar, brown-spar, heavy-spar, fluor-spar, and hornstone.

Geographic Situation.

Europe.—This ore was formerly met with in the workings for silver at Alva in Stirlingshire; it has also been found massive and in cubes at Herland in Cornwall, and in the same county, at Huel Duchy, with red and native silver; at Huel Basset with galena, and in a copper mine at Dolcoath: at Kongsberg, it occurs in veins, along with native silver, and various ores of that and other metals; in the Hartz, in veins that traverse grey-wacke; in Saxony, in veins in gneiss; in veins in the granite of Altwolfach in Suabia; at Annaberg in Lower Austria, in veins that traverse compact grey-coloured limestone; at Joachimsthal in Bohemia, in mica-slate and clay-slate; in porphyritic-syenite at Schemnitz in Hungary; and in Sardinia, along with corneous silver, and native silver.

Asia.—At Schlangenberg in Siberia.

America.—This ore is very common in the mines of Guanaxuato and Zacatecas, as well as in the *Veta Biscaina* of Real del Monte in Mexico; but in Peru, where it also occurs, it is much less abundant.

Uses.

It is highly valued as an ore of silver.

Observations.

Observations.

1. Compact Silver-Glance is distinguished from native silver, whether fresh or tarnished, by its colour, streak, and inferior specific gravity.

2. This mineral has received the name *Silver-Glance* from its shining appearance: it is also named *Vitreous Silver-ore*, from the German name *Glaserz*, which, however, is but a corruption of glanz-erz.

Second Subspecies.

Earthy Hexahedral Silver-Glance, or Earthy Vitreous Silver.

Silberschwärze,* *Werner*.

Silberschwärze, *Wid.* s. 694.—Sooty Silver-ore, *Kirw.* vol. ii. p. 117.—Silberschwärze, *Estner*, b. iii. s. 365. *Id. Emm.* b. ii. s. 173.—L'Argent noir, *Broch.* t. ii. p. 132.—Silberschwärze, *Reuss*, b. iii. s. 338. *Id. Lud.* b. i. s. 213. *Id. Suck.* 2ter th. s. 141. *Id. Bert.* s. 363. *Id. Mohs*, b. iii. s. 141. *Id. Leonhard*, Tabel. s. 54. *Id. Karsten*, Tabel. s. 60.—Erdiges Glanzerz, *Haus.* s. 71.—Erdiges Glanzerz, *Haus.* Handb. b. i. s. 138.—Silberschwärze, *Hoff.* b. iii. s. 55.—Black sulphureted Silver, *Aikin*, p. 77.

External Characters.

Its colour is bluish-black, which sometimes inclines to blackish lead-grey.

It seldom occurs massive, sometimes disseminated, but generally as a coating or crust

It varies from friable to solid.

 Internally

Internally it is dull, passing into feeble metallic glimmering.

When friable, it occurs in feeble glimmering dusty particles, but when solid, its fracture is fine earthy, inclining to uneven.

The fragments are blunt-edged.

It is feebly translucent.

It is very soft, sometimes passing into friable.

It affords a metallic shining streak.

It soils a little.

It is easily frangible.

It is sectile.

Chemical Characters.

It is easily fusible; is converted into a slaggy mass, containing globules of impure silver.

Constituent Parts.

It appears to be a Sulphuret of Silver.

Geognostic Situation.

It occurs in veins in primitive mountains, in which it is generally associated with compact silver-glance, corneous silver, brittle silver-glance, native silver, native gold, ochry brown iron-ore, quartz, and straight lamellar heavy-spar.

Geographic Situation.

Europe.—It occurs principally in the Saxon Erzgebirge, in veins, along with other ores of silver; at Kremnitz, along with native gold, silver-glance, and amethyst; near Schemnitz, in ironshot quartz, with white lead-spar, and malachite; in Chalanches, near Allemont in Dauphiny, with native silver, earthy black cobalt, red cobalt, ochre

ochre of nickel, and calcareous-spar; and in the mines of Kongsberg.

Asia.—At Schlangenberg in Siberia, along with iron-pyrites, blende, auriferous native silver, and hornstone.

2. Rhomboidal Silver-Glance, or Brittle Silver-Glance.

Sprödglaserz, *Werner.*

Argent fragile, *De Born,* t. ii. p. 429.—Sprödglaserz, *Wid.* s. 669. *Id. Werner,* Pabst. b. i. s. 41.—Sprödes Silber-glanzerz, *Estner,* b. iii. s. 398.—Sprödglaserz, *Emm.* b. ii. s. 180.—L'Argent vitreux aigre, *Broch.* t. ii. p. 138.—Argent noire, *Haüy,* t. iii. p. 416.—Sprödglanzerz, *Reuss,* b. iii. s. 351. *Id. Lud.* b. i. s. 215. *Id. Suck.* 2ter th. s. 148. *Id. Bert.* s. 370. *Id. Mohs,* b. iii. s. 160. *Id. Leonhard,* Tabel. s. 54.—Argent rouge aigre, *Brong.* t. ii. p. 254.—Sprödglanzerz, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 71.—Argent antimonié sulphuré noir, *Haüy,* Tabl. p. 76.—Brittle sulphureted Silver, *Aikin,* p. 78.

External Characters.

Its colour is intermediate between iron-black and blackish lead-grey, and has sometimes a tempered-steel tarnish.

It seldom occurs massive, more frequently disseminated, and very often crystallised.

Its primitive form is a rhomboid, whose magnitude is unknown; the following are its secondary figures:

1. Equiangular six-sided prism, with straight or convex terminal faces.
2. The preceding figure, rather acutely acuminated by six planes, which are set on the lateral planes, and

and the extremities of the acuminations sometimes very deeply truncated.

3. Equiangular six-sided table. In this figure the lateral edges are sometimes truncated.
4. Double six-sided pyramid.

The tabular crystals often intersect one another, and thus form the cellular external shape; sometimes they are superimposed. The crystals are seldom middle-sized, usually small, and very small, and even microscopic.

The lateral planes, particularly of the prism, are longitudinally streaked; in the other figures the planes are sometimes smooth, sometimes drusy.

Externally it is highly splendent.

Internally it is shining, inclining to glistening, and the lustre is metallic.

The cleavage not discernible.

The fracture alternates from small conchoidal to fine-grained uneven.

The fragments are indeterminate angular, and rather blunt-edged.

The lustre is not increased in the streak.

It is soft.

It is sectile.

It is easily frangible.

Specific gravity 5.7,—6.1, *Mohs.*

Chemical Characters.

Heated on charcoal before the blowpipe, it melts with difficulty, and the sulphur, arsenic and antimony, are in part volatilised. A globule of imperfectly malleable silver, accompanied with a brown scoria, remains behind.

Constituent

Constituent Parts.

According to Klaproth, the brittle silver-glance from the mine Hoffnung Gottes in Gross-Voightsberg near Freyberg, affords

Silver, -	66.50
Sulphur, -	12.00
Antimony, -	10.00
Iron, - -	5.00
Copper and Arsenic,	0.50
Earthy substances, -	1.00
	95.00

Klaproth, Beit. b. i. s. 166.

Geognostic Situation.

It occurs in veins that traverse gneiss, clay-slate, and porphyry, and in these it is accompanied with other ores of silver; also ores of lead, zinc, copper, cobalt, iron, and more rarely gold, and also with quartz, calcareous-spar, and brown-spar.

Geographic Situation.

Europe.—This mineral occurs in the district of Freyberg in Saxony, in veins, along with native silver, hexahedral silver-glance, dark red silver, white silver, galena or lead-glance, black blende, &c. with brown-spar, calcareous-spar, and quartz, seldomer with heavy-spar and fluor-spar: in the Upper Erzgebirge, both on the Saxon and Bohemian sides, it is associated with light red silver, white cobalt, native arsenic, hexahedral silver-glance; also native silver, iron-pyrites, copper-pyrites, brown-spar, and calcareous-spar, and these veins occur in gneiss and clay-slate.
In

In Hungary, it occurs at Chemnitz and Kremnitz; at Chemnitz, it is associated with hexahedral silver-glance, rhomboidal copper-glance, galena or lead-glance, iron-pyrites, brown and black blende, dark red silver, and very rarely light red cinnabar, and native gold, calcareous-spar, brown-spar, and calcedony; in the mines at Kremnitz, it is usually accompanied with quartz, brown-spar, amethyst, iron and copper pyrites, dark red silver, and seldomer with native gold: at Joachimsthal in Bohemia, the ores and earthy minerals with which it is accompanied are dark red silver, hepatic pyrites, calcareous-spar, and brown-spar.

Asia.—In Siberia it is accompanied with granular heavy-spar, copper-pyrites, blue copper, and brown blende.

America.—In the mine of Ecateras in Mexico; and also in the silver mines of Peru.

Observations.

1. It is characterised by colour, form, fracture, sectility, easy frangibility, and specific gravity. It is distinguished from *Hexahedral Silver-glance* by its higher lustre, crystallizations, fracture, and want of malleability; from *Iron-glance* by its inferior hardness, and its retaining its colour in the streak.

2. It has been described under the names *Röscherz*, *Roschgewächs*, *Roschgewir*, and some of the varieties of Schwarzgiltigerz belong to it.

* White

White Silver.

Weiss-Giltigerz, *Werner.*

Id. Werner, Pabst. b. i. s. 58. *Id. Wid.* s. 711.—Light Grey Silver-ore, *Kirw.* vol. ii. p. 119.—Weiss-Giltigerz, *Estner.* b. iii. s. 443. *Id. Emm.* b. ii. s. 195.—La Mine blanche riche, *Broch.* t. ii. p. 150.—Weiss-Gultigerz, *Reuss,* b. iv. s. 193. *Id. Lud.* b. i. s. 217. *Id. Mohs,* b. iii. s. 193. *Id. Leonhard,* Tabel. s. 55.—Argent blanc, *Brong.* t. ii. p. 255.—Weiss-Gultigerz, *Karsten,* Tabel. s. 68. *Id. Haus.* s. 74.—Plomb sulphuré antimonifere et argentifere, *Haüy,* Tabl. p. 89.—Weissgiltigerz, *Hoff.* b. iii. s. 78. *Id. Haus.* Handb. b. i. s. 177.—White Silver, *Aikin,* p. 78.

External Characters.

Its colour is very light lead-grey ; but when it approaches to brittle silver-glance, it inclines somewhat to black.

It occurs massive and disseminated, and always associated with lead-glance.

Internally it alternates from glimmering to glistening, and the lustre is metallic. The varieties that verge on silver-glance have the greatest lustre; those that pass into plumose antimony the least.

The fracture is even, and fine-grained uneven. When fine-grained uneven, it is passing into brittle silver-glance ; when intermixed with delicate fibres, it is passing to indurated plumose antimony: Therefore the characteristic fracture of the true white silver is even.

The fragments are indeterminate angular and blunt-edged.

Its lustre is rather increased in the streak, and the colour is not changed.

It

It is soft, approaching to very soft.

It is sectile.

It is easily frangible.

Specific gravity, 5.322, *Gellert*; 5.622, *Breithaupt*.

Chemical Characters.

Before the blowpipe, it melts, and partly evaporates, leaving a bead of impure silver, surrounded by a yellow powder.

Constituent Parts.

	Dark White Silver from Himmelsfürst near Freyberg.	Light White Silver from Himmelsfürst.
Lead, -	41.00	48.06
Silver, -	9.25	20.40
Antimony, -	21.50	7.88
Iron, -	1.75	2.25
Sulphur, -	22.0	12.25
Alumina, -	1.00	7.00
Silica, -	0.75	0.25
	97.25	99.09
	Klaproth, Beit. b. i. s. 175.	Ibid. s. 172.

Geognostic and Geographic Situations.

It occurs in veins that traverse gneiss, along with galena or lead-glance, dark red silver, brittle silver-glance, plumose antimony, arsenical and iron pyrites, black blende, brown-spar, calcareous-spar, and quartz.

It is found in considerable quantity in the mines of Himmelsfürst and Beschert Glück, near Freyberg, but rarely in other countries.

It is said to have been found in small quantity in the Hartz, and also in Bohemia.

Observations.

Observations.

1. This ore is more nearly allied to galena than to silver-glance, and it is probable that it will be removed from its present place, as soon as all its characters shall have been fully ascertained.

2. It is characterised by its colour, fracture, sectility, and weight; it is distinguished from *Brittle Silver-glance*, by its colour, want of crystallization, inferior lustre, and inferior specific gravity; from *Hexahedral Silver-glance*, by colour and want of sectility.

3. It is nearly allied to grey antimony and compact lead-glance, and also to brittle silver-glance.

** Grey Silver, or Carbonate of Silver.

Grausilber, *Hausmann.*

Luftsaures Silber, *Wid.* Min. s. 689.—L'Argent carbonaté, *Broch.* t. ii. p. 155.—Kohlensaures Silber, *Reuss,* Min. b. ii. 3. s. 376.—Argent carbonaté, *Lucas,* t. ii. p. 293.—Kohlensaures Silber, *Leonhard,* Tabel. s. 55.—Argent carbonaté, *Haüy,* Tabl. p. 76.—Grausilber, *Haus.* Handb. b. iii. s. 1008.—Carbonated Silver, *Aikin,* p. 80.

External Characters.

Its colour is ash-grey, which passes into greyish-black, and iron-black.

It occurs massive and disseminated.

Its lustre is glistening.

The fracture is uneven, inclining to earthy.

It is soft.

It

It becomes more shining in the streak.
It is brittle, passing into sectile.
It is heavy.

Chemical Characters.

It is easily reduced before the blowpipe. It effervesces with nitrous acid.

Constituent Parts.

Silver, -	72.5	
Carbonic Acid, -	12.0	
Oxide of Antimony, and a trace of Copper,	15.5	
	100.0	*Selb.*

Geognostic and Geographic Situations.

It occurs in veins that traverse granite, in the mine of Wenzeslaus, at Altwolfach in the Black Forest. In these veins, it is associated with native silver, silver-glance, and heavy-spar.

Observations.

The characters of this mineral are still but imperfectly known, so that it is of no great importance where it is placed. Its present situation is therefore to be considered as temporary.

GENUS III.

Genus III.—GALENA or LEAD-GLANCE.

This genus contains but one species, viz. Hexahedral Galena.

1. Hexahedral Galena, or Lead-Glance.

Hexaedrischer Bleiglanz, *Mohs.*

This species is divided into three subspecies, viz. Common Galena, Compact Galena, and Friable Galena. * Blue Lead. ** Cobaltic Galena.

First Subspecies.

Common Galena or Lead-Glance.

Gemeiner Bleiglanz, *Werner.*

Id. Werner, Pabst. b. i. s. 97. *Id. Wid.* s. 841.—Common Galena, *Kirw.* vol. ii. p. 216.—Gemeiner Bleiglanz, *Emm.* b. ii. s. 369.—Plomb sulphuré, Galene, *Lam.* t. i. p. 289.–292.—Plomb sulphuré, *Haüy,* t. iii. p. 456.—La Galene commune, *Broch.* t. ii. p. 295.—Gemeiner Bleiglanz, *Reuss,* b. iv. s. 174. *Id. Lud.* b. i. s. 258. *Id. Suck.* 2ter th. s. 306. *Id. Bert.* s. 445. *Id. Mohs,* b. iii. s. 469.—Blættriges Bleiglanz, *Hab.* s. 126.—Plomb sulphuré, *Lucas,* p. 114.—Gemeiner Bleiglanz, *Leonhard,* Tabel. s. 70.—Plomb sulphuré laminaire, *Brong.* t. ii. p. 195. *Id. Brard,* p. 265.—Bleiglanz, *Karsten,* Tabel. s. 68. *Id. Haus.* s. 74.—Sulphuret of Lead, *Kid,* vol. ii. p. 130.—Plomb sulphuré forme determ., &c. *Haüy,* Tabl. p. 79.—Gemeiner Bleiglanz, *Hoff.* b. iv. s. 4.—Galena, *Aikin,* p. 107.

External

External Characters.

Its colour is fresh lead-grey of different degrees of intensity *. On the surface, it sometimes shows a tempered-steel or iridescent tarnish †.

It occurs most frequently massive, and disseminated; also in membranes, in angular pieces, in grains, reticulated, specular, botryoidal, corroded, and amorphous, seldom fused-like and cylindrical ‡; also in granular distinct concretions, of all degrees of magnitude, from large to very small granular: sometimes in lamellar, rarely in prismatic concretions; frequently crystallised.

1. *Cube* ||, Pl. 11. fig. 220. which is the primitive figure, exhibits the following varieties:
   a. In which the faces are either straight or convex, or concave.
   b. Truncated on all the angles §, Pl. 11. fig. 221.
   c. Truncated on all the angles and edges ¶, Pl. 11. fig. 222.
   d. Bevelled on all the edges, Pl. 11. fig. 223.
2. *Octahedron* **, Pl. 11. fig. 224. which exhibits the following varieties:

a. Cuneiform

* Those varieties having a blackish lead-grey colour, contain the greatest quantity of silver, and not the pale varieties, as has been often imagined.

† When intimately intermixed with other minerals, as with blende and calcareous-spar, it acquires a peculiar glimmering aspect.

‡ The cylindrical and botryoidal varieties never occur in pure galena, but in those varieties which are intermixed with fibrous brown blende or with hepatic pyrites.

|| Plomb sulphuré primitif, Haüy.

§ Plomb sulphuré cubo-octaedre, Haüy.

¶ Plomb sulphuré triforme, Haüy.

** Plomb sulphuré octaedre, Haüy.

a. Cuneiform or elongated, Pl. 11. fig. 225.

b. The edges rounded, and the faces concave.

c. Truncated on all the edges *, Pl. 11.fig. 226.

d. Truncated on all the angles, and the edges of the truncations truncated †, Pl. 11. fig. 227.

e. In which all the angles and edges are truncated at the same time.

f. All the angles truncated, and the edges bevelled ‡, Pl. 11. fig. 228.

g. All the edges bevelled, and the edges of the bevelment, and also the angles, truncated ||, Pl. 11. fig. 229 §.

3. Rectangular four-sided prism, acuminated on both extremities with four planes, which are set sometimes on the lateral planes, sometimes on the lateral edges, and the summits of the acuminations truncated, Pl. 11. fig. 230.

4. Broad unequiangular six-sided prism, acutely bevelled on the extremities; the bevelling-planes set on the acute lateral edges.

5. Six-sided table, with bevelled terminal planes.

6. Three-sided table, in which the angles and terminal planes are bevelled, or in which the terminal planes and edges are bevelled.

The

* Plomb sulphuré pantogene, Haüy.

† Plomb sulphuré unibinaire, Haüy.

‡ Plomb sulphuré octotrigesimal, Haüy.

|| Plomb sulphuré pentacontaedre, Haüy.

§ Of the different varieties of crystallized galena, the cubical is the poorest in silver; the cube truncated on the angles the richest; and the octahedral and prismatic are those which are most frequently associated with rich silver ores.

The crystals are usually middle-sized, small, and very small; seldom large. They are generally superimposed, or in druses, but seldom imbedded.

The planes of the crystals are smooth, drusy, or rough.

Externally it alternates from specular splendent to glimmering, according as the surface is smooth, drusy or rough.

Internally it alternates from specular splendent to glistening, and the lustre is metallic.

The cleavage is rectangular, threefold, and parallel with the sides of the cube,—or we say it is hexahedral. The folia of the cleavage are more or less perfect, generally straight, sometimes floriform, and scaly.

The fragments are cubical.

The streak is shining.

It is harder than gypsum, but not so hard as calcareous-spar.

It is perfectly sectile.

It is uncommonly easily frangible.

Specific gravity, 7.0,—7.6, *Mohs*; 7.220, *Muschenbröck*; 7.290, *Gellert*. The crystallized, 7.5873, *Brisson*; 7.786, *Watson*. From the Hartz, 7.447, *Kirwan*. From Kampfstein, 7.100, *Vanquelin*. From Eckelsberg, from 7.300 to 7.600, *Vauquelin*.

Chemical Characters.

Before the blowpipe it flies into pieces, then melts, emitting a sulphureous odour, and a globule of metallic lead remains. When it is alternately heated and cooled, it at length disappears entirely; and if it be argentiferous, a minute globule of silver remains behind.

Constituent Parts.

According to Vauquelin, galena or lead-glance contains the following ingredients:

	From Kirschwald in Deux Ponts.	Kampf-stein.	Eckles-berg.	Kanten-bach.
Lead,	54	69	68.69	64
Sulphur,	8	16	16.18	18
Calcareous-earth and silica,	38	15	16.13	18
	—	—	—	—

All those specimens appear impure, so that the analyses are not of so much value as those that follow:

	Klausthal.			Durham.
Lead,	83.0	77	Lead,	85.13
Sulphur,	16.41	20	Sulphur,	13.02
Silver,	0.08	1	Iron,	0.50
Westrumb.	99.49	*Kirwan.* 98	*Thomson.*	98.65

Probably every variety of galena contains silver. The quantity varies from a very small portion to 4½ ounces in the hundred weight. Those varieties that afford less than one ounce of silver in the hundred weight, are considered as poor in silver, while those which afford from 2 ounces to 4½ ounces, are considered as rich. It is said that 11½ ounces of silver to the ton, is the general average of the lead in the North of England. That of Huel Pol in Cornwall yielded 60 ounces: that of Guarneck, near Truro, 70 ounces, and one ton of the ore of the South Hoo mine, near Beeralstone in Devonshire, yielded 135 ounces of silver. Some varieties of galena yield gold, as

that of Kremnitz in Hungary, and others a small proportion of antimony, as that of Dufton, in the North of England.

The whole of the lead-mines in Great Britain produce annually from 45,000 to 48,000 tons of lead, which is principally obtained from galena.

Geognostic Situation.

It occurs in veins, beds, and imbedded masses, and is not confined to any particular class of rocks, for it occurs in primitive, transition, and secondary mountains. In primitive rocks it is met with in beds, subordinate to gneiss, mica-slate and clay-slate, and associated with blende and iron-pyrites; and in veins in primitive limestone. It occurs in beds in grey-wacke, and in veins traversing that rock and clay-slate. It forms beds along with calamine in the older flœtz or secondary limestones; occurs in veins and imbedded portions, and disseminated in shell limestone and conglomerate; and in veins, and disseminated in limestone and sandstone, belonging to the coal formation.

Geographic Situation.

Europe.—At Leadhills, in Lanarkshire, it occurs in veins that traverse transition rocks along with white lead-spar, green lead-spar, earthy lead-spar, sulphate of lead, calamine, ochry brown iron-ore, brown hematite, iron-pyrites, sparry iron, blue copper, manganese-ore, brown spar, calcareous-spar, heavy-spar, and mountain-cork. The same formation extends into the upper part of Dumfries-shire, where it forms the mines of Wanlockhead. It occurs along with fluor-spar, in veins that traverse granite at Monaltrie, in Aberdeenshire; in the old lead-mines of Clifton at Tyndrum, already described; in veins that traverse

traverse gneiss, along with heavy-spar and calcareous-spar, at Strontian in Argyleshire; in veins that traverse sandstone, along with heavy-spar and calcareous-spar, at Cumberhead in Lanarkshire; in small veins or disseminated in the grey sandstone of the coal formation in the Lothians and Fifeshire; in veins traversing limestone, in the island of Isla; veins traversing gneiss, in the isle of Coll; and in conglomerate rocks near Stromness in Orkney. It forms large veins in limestone, in Northumberland, Durham, Derbyshire, Flintshire, Somersetshire, and in slate in Shropshire, and most of the counties of Wales *. In the mines of Derbyshire, the galena or lead-glance is associated with white lead-spar, or green lead-spar, heavy-spar, calcareous-spar, and fluor-spar, and some ores of zinc and iron. Fluor-spar is one of the most common vein-stones in that country; and there are some places in which the veins are entirely filled up with fluor-spar. It is also met with in clay-slate, in Devonshire and Cornwall. It occurs in veins in primitive limestone at Sala, and in beds, along with copper-pyrites, iron-pyrites, and blende, also at Fahlun, in Sweden. In veins that traverse transition rocks, or in beds subordinate to these, in the Hartz, and in veins in gneiss, in the Saxon Erzgebirge. Disseminated, and in nests, in shell limestone, as at Kulf, near Brugen, in the *ci-devant* kingdom of Westphalia, and in the vicinity of Göttingen. At Mus in Bohemia, in veins that traverse clay-slate, associated with white, black, and green lead-spar, blende. copper-pyrites, malachite, iron-pyrites, quartz, and heavy-spar. At Prizbram, also in Bohemia, where it occurs in veins that traverse clay-slate, it is accompanied with black

 and

* Aikin's Manual, 2d edit. p. 108.

and green lead-spar, blende, white silver, native silver, sparry iron, grey and white antimony, iron-pyrites, heavy-spar, calcareous-spar and quartz. At Bleyberg, in Carinthia, it is accompanied with white, yellow, and black lead-spars, calamine, yellow and brown blende, and mountain-cork. At Offenbanya in Transylvania, it is associated with grey copper, grey antimony, iron-pyrites, and brown blende, in a bed of granular limestone; at Nagyag, with red antimony, and amethyst, in clay-porphyry. At Querbach in Silesia it is accompanied with black blende, cobalt-glance, magnetic iron-ore, iron-pyrites, copper-pyrites, arsenical pyrites, garnet, and calcareous-spar; and at Altenberg in the same country, along with iron-pyrites, copper-pyrites, arsenical-pyrites, copper-glance or vitreous copper-ore, calcareous-spar and quartz. Besides the countries above enumerated, the following may be added, as affording galena or lead-glance: Swabia, Bavaria, the Tyrol, Salzburg, Upper Austria, the Bannat, France, (in which the most considerable mines are those of Pompæan, Poullaouen, and Huelgoët), Italy and Spain.

Asia.—This ore does not occur so abundantly in Asia as in Europe; it is met with at Irkutzk, Kolywan, and in the Uralian districts. Lead-ore, (I presume galena or lead-glance), is found at Dessouly in Higher Hindostan, about fifty coss east of Sirinagur; and we are informed by Captain Turner, that at a place situated nearly two days journey from Tessoolumboo in Thibet, there is a mine of this mineral. In Lower India, it has been met with in small quantities at Jangumrauzpillay, in the Cumtum district. The greater part, however, of the lead met with in the Peninsula of India comes from Siam *, and

* Elmore's Guide to the Indian Trade, p. 309.

Araccan, and occasionally from the Burmah dominions *; it is also found at Omon in Arabia †.

America.—It occurs in Upper Louisiana, Virginia, Maryland, Pennsylvania, New-York, Connecticut, Vermont, Massachusets, and Maine ‡. It is met with as far north as Greenland, where it is associated with cryolite, brown-spar, sparry iron, and iron-pyrites.

It abounds in a flœtz limestone in the north-eastern parts of New Spain, particularly in the district of Zimapan; in the kingdom of New Leon; and in the province of New Santander. In these districts the galena contains a small portion of silver, and is generally worked more for its silver than its lead. Mines of this ore also occur in Chili in South America.

Uses.

Nearly all the lead of commerce is obtained from galena. In order to obtain the lead the ore is first roasted, in order to drive off the sulphur, and then mixed with the necessary quantity of coke, charcoal, or peat, and reduced in a common furnace. The lead which remains after the operation of roasting, is in an oxydated state; the inflammable matter, with which it is mixed in the furnace, decomposes the metallic oxide; and combining with its oxygen, flies off in the form of carbonic acid gas, while the lead is reduced to the metallic state, and sinks to the bottom of the furnace. Almost all the varieties of galena or lead-glance, contain a greater or less portion of silver. The

* Oriental Repertory, vol. i, p. 117.

† Ainslie's Materia Medica of Hindostan, p. 56.

‡ Cleaveland's Mineralogy, p. 513, 514.

The silver, after the reduction of the lead, may be separated by the process of cupellation; but in the greater number of instances, the quantity of silver is so inconsiderable, as not to repay the expence of labour; and hence the lead of commerce almost always contains a minute portion of silver. Galena is also used for glazing pottery.

Observations.

1. Some dark-coloured varieties of galena might, with a superficial observer, be confounded with *blende*, or sulphuret of zinc; but the lustre of the zinc-ore is destroyed by scratching the surface with a knife, which is not the case with the galena or lead-glance. If both are breathed upon, the galena recovers its lustre in a moment; the blende very slowly. Galena is distinguished from *graphite* by its colour, greater specific gravity, and by the comparatively faint trace it leaves on paper. The same marks will serve to distinguish it from *molybdena*, which possesses, besides a foliated fracture, a considerable degree of flexibility.

2. Galena, which occurs in beds, is said to contain less silver than that found in veins.

3. The galena in veins appears frequently to have experienced considerable alterations since its formation,—the fused-like and corroded form may be considered as changed galena, and the numerous empty spaces in lead veins are owing to the gradual abstraction of galena, which may have furnished materials for the formation of various lead-spars. In my Elements of Geology, it is intended to give an account of the various changes that are taking place in metalliferous and other minerals in the bowels of the earth.

Second

Second Subspecies.

Compact Galena, or Lead-Glance.

Bleischweif, *Werner.*

Plumbum Plumbago, *Wall.* t. ii. p. 305.—Bleischweif, *Werner*, Pabst. b. i. s. 114. *Id. Wid.* s. 845.—Galene compacte, *De Born*, t. ii. p. 355.—Compact Galena, *Kirw.* vol. ii. p. 218.—Bleischweif, *Emm.* b. ii. s. 377.—Plomb sulphuré compacte, *Haüy*, t. iii. p. 461.—La Galene compacte, *Broch.* t. ii. p. 301.—Bleischweif, *Reuss*, b. iv. s. 188. *Id. Lud.* b. i. s. 259.—Dichter Bleiglanz, *Suck.* 2ter th. s. 312.—Bleischweif, *Bert.* s. 447. *Id. Mohs*, b. iii. s. 486. *Id. Hab.* s. 127.—Dichtes Bleiglanz, *Leonhard*, Tabel. s. 71.—Plomb sulphuré compacte, *Brong.* t. ii. p. 195.—Bleischweif, *Karsten*, Tabel. s. 68. *Id. Haus.* s. 74.—Plomb sulphuré compacte, *Haüy*, Tabl. p. 80.—Bleischweif, *Haus.* Handb. b. i. s. 178. *Id. Hoff.* b. iv. s. 11.—Compact Galena, *Aikin*, p. 108.

External Characters.

Its colour is fresh lead-grey, which is in general darker than in common galena.

It occurs massive, disseminated, and specular; and rarely in the curved lamellar concretions.

The specular variety is smooth, splendent, shining, or glimmering and streaked.

Internally it is strongly glimmering, and the lustre is metallic.

The fracture is even, which in some varieties passes into flat conchoidal.

The fragments are indeterminate angular, and not particularly sharp edged.

It acquires a stronger lustre in the streak.

It

It agrees with the preceding subspecies in its other characters.

Constituent Parts.

It is a compound of Sulphuret of Lead and Sulphuret of Antimony, and a small portion of Silver.

Geognostic Situation.

It occurs in veins, and is usually accompanied with common galena or lead-glance. It is worthy of remark, that when the two subspecies occur together, the compact always forms the sides of the vein, and this probably owing to its having been in a less perfect state of solution. It is also accompanied with black blende, common iron-pyrites, copper-pyrites, quartz, and heavy-spar.

Geographic Situation.

Europe.—It is found at Leadhills in Lanarkshire; in Derbyshire; Sahlberg in Westermannland; in the Hartz; Freyberg and Gersfdorf in Saxony; Rauschenberg in Upper Bavaria; Weiding in the Upper Palatinate; Leogang in Salzburg; Servoz, in the valley of Chamouni in Switzerland.

Asia.—Siberia.

Observations.

1. It seldom occurs pure, being generally intermixed with common galena or lead-glance. A mixture of this kind is described under the name *Galena striata*, by some of the older mineralogists; *Plumbum stibiatum*, Lin.; *Galena plumbi antimonialis*, Waller. Syst. Min. t. ii. p. 305.; *Plomb sulphuré strié*, Haüy; *Stripmalm* of the Swedes.

2. The

2. The specular variety is known in Derbyshire under the name *Slikensides*, a term somewhat expressive of its smooth form. It occurs lining the walls of very narrow rents. It has a most remarkable property, that when the rock in which it is contained is struck with a hammer, a crackling noise is heard, which is generally followed by an explosion of the rock, in the direction and neighbourhood of the vein. The cause of this singular effect has not been satisfactorily explanied.

Third Subspecies.

Friable Galena or Lead-Glance.

Mulmiger Bleiglanz, *Werner.*

External Characters.

Its colour is dark fresh lead-grey.

It occurs massive and in thick flakes. It is composed of metallic glimmering scaly parts, which are more or less coherent, and which do not soil.

It passes from friable into very soft.

It is sectile.

Geognostic and Geographic Situations.

It has been hitherto found only in the lead and silver-mines around Freyberg in Saxony.

Observations.

1. It appears to be formed by the decomposition of common lead-glance, and bears the same relation to common lead-glance that copper-black does to copper-glance, and silver-black to silver-glance.

2. Weiss

2. Weiss describes a mineral under the name Quartzy Compact Galena, (Quarziger Bleischweif,) which appears to be a mere mixture of quartz, galena, and iron and copper pyrites.—Vid. Berlin, Naturforschender Freünde, ii. s. 79.

3. A friable variety of lead-glance, found in the Dufton lead-mines, which probably belongs to this subspecies, is so highly inflammable as to take fire and burn, on being held in the flame of a candle.

Blue-Lead.

Blau Bleierz, *Werner.*

Plumbi nigri crystallis regularibus, *Waller.* t. ii. p. 309.?—Blau Bleierz, *Werner,* Pabst. b. i. s. 115. *Id. Wid.* s. 847.—Blue Lead-ore, *Kirw.* vol. ii. p. 220.—Blau Bleierde, *Emm.* b. ii. s. 380.—Plomb noire, *Haüy,* t. iii. p. 497.—La Mine de Plomb bleue, *Broch.* t. ii. p. 303.—Blaubleierz, *Reuss,* b. i. s. 209. *Id. Lud.* b. i. s. 260. *Id. Suck.* 2ter th. s. 322. *Id. Bert.* s. 453. *Id. Mohs,* b. iii. s. 487. *Id. Leonhard,* Tabel. s. 71.—Plomb noir, *Brong.* t. ii. p. 199.—Blaubleierz, *Karsten,* Tabel. s. 68.—Plomb sulphuré epigene prismatique, *Haüy,* Tabl. p. 83.—Blaubleierz, *Haus.* Handb. b. iii. s. 1092. *Id. Hoff.* b. iv. s. 13.—Blue Lead, *Aikin,* p. 109.

External Characters.

Its colour is intermediate between very dark indigo-blue and dark lead-grey, and which externally sometimes inclines to black.

It occurs massive, and crystallized in regular six-sided prisms, which are usually small, low, sometimes bulging, and with a rough and dull surface.

Internally

Internally it is feebly glimmering, and the lustre is metallic.

The fracture is even; sometimes it approaches to small and flat conchoidal.

The fragments are indeterminate angular.

It is opaque.

The streak is shining and metallic.

It is soft, inclining to very soft.

It is sectile.

It is easily frangible.

Specific gravity 5.461, *Gellert.*

Chemical Characters.

It melts easily before the blowpipe, emitting a pungent sulphureous vapour, and is reduced to the metallic state.

Constituent Parts.

It is conjectured to be sulphuret of lead intermixed with phosphat of lead.

Geognostic and Geographic Situations.

It occurs in veins, accompanied with black lead-spar, brown lead-spar, white lead-spar, malachite, radiated blue copper, quartz, fluor-spar, and heavy-spar.

It is a rare fossil, having hitherto been found only at Zschoppau in Saxony, and Huelgöet in France.

Observations.

It is distinguished from *Galena* or *Lead-glance* by its colour, form, its crystals appearing to belong to the rhomboidal series, inferior lustre, and lower specific gravity.

** Cobaltic Galena or Lead-glance.

Kobaltbleierz, *Hausmann.*

Kobaltbleierz, *Haus.* s. 75. *Id. Haus.* Handb. b. i. s. 138.—Kobalt-Bleiglanz, Nordeutch. Beitr. z. Berg und Hüttenk. iii. s. 120.

External Characters.

Its colour is fresh lead-grey.

It occurs fine and minutely disseminated, and in extremely minute crystals, which are aggregated in a moss-like form.

Its lustre is shining and metallic.

It is small and fine scaly foliated.

It occurs in fine granular distinct concretions.

It is opaque.

It is soft.

It is sectile.

It soils feebly.

Chemical Character.

Before the blowpipe it splits into small pieces; and communicates a smalt-blue colour to glass of borax.

Geognostic and Geographic Situations.

It occurs in small quantity in a vein in transition rocks, in the mine of Lorenz near Clausthal in the Hartz.

Observations.

This ore was first discovered by M. Bauersach of Zellerfeld. An ore of this kind is mentioned by Proust as occurring in Catalonia *.

GENUS IV.

* Proust, Journ. de Phys. lxiii. Nov. 1806.

GENUS IV.—BLACK TELLURIUM.

Blätter-glanz, *Mohs.*

This genus contains but one species, viz. Prismatic Black Tellurium.

1. Prismatic Black Tellurium.

Prismatischer Blätter-glanz, *Mohs.*

Nagyagerz, *Werner.*

Id. Wid. s. 671.—Or gris lamelleux, *De Born,* t. ii. p. 463.—Blättererz, *Karst.* Tabel. 56.—Nagyagerz, *Emm.* b. ii. s. 121.—Mine d'Or de Nagyag, *Lam.* t. i. p. 110.—Tellure natif aurifere et plombifere, *Haüy,* t. iv. p. 327.—La Mine de Nagyag, ou le Silvane lamelleux, *Broch.* t. ii. p. 486.—Blättererz, *Reuss,* b. iv. s. 615.—Nagyagerz, *Lud.* b. i. s. 311.—Blätter Tellurerz, *Suck.* 2ter th. s. 497.—Blättererz, *Bert.* s. 522. *Id. Mohs,* b. iii. s. 70. *Id. Leonhard,* Tabel. s. 80.—Tellur natif plombifere, var. feuilleté, *Brong.* t. ii. p. 124.—Blättererz, *Karsten,* Tabel. s. 70.—Blätter Tellur, *Haus.* s. 71.—Tellur natif auro-plombifere, laminaire et lamelliforme, *Haüy,* Tabl. p. 119.—Blätter Tellur, *Haus.* Handb. b. i. s. 132.—Nagyager-erz, *Hoff.* b. iv. s. 134.—Black Tellurium, *Aikin,* p. 141.

External Characters.

Its colour is intermediate between blackish lead-grey, and iron-black.

It

It occurs massive, disseminated, in leaves, and crystallised.

Its primitive figure is an oblique four-sided prism, the dimensions of which are unknown. The following are the secondary figures which have been observed:

1. Oblique four-sided table.
2. Six-sided table.
3. Eight-sided table.
4. Acute double four-sided pyramid, truncated on the summits.

Externally it is splendent, and the lustre is metallic.

Internally it is shining.

The cleavage is either prismatoidal or axifrangible, and the folia are often curved.

The fragments are tabular.

It is harder than talc, but not so hard as gypsum.

It is sectile; it is the most sectile of the ores of tellurium.

It soils slightly.

The thin leaves and tables are flexible.

Specific gravity 7.0,—7.2, *Mohs.*

Chemical Characters.

It melts very easily before the blowpipe; the sulphur and tellurium are soon volatilised, and a blackish-brown coloured globule remains, which, on being melted with borax, affords an argentiferous gold globule; the slag which remains, tinges borax violet-blue. It dissolves with effervescence in acids; the nitrico-muriatic acid extracts the gold from it.

Constituent Parts.

Tellurium,	-	32.2
Lead,	-	54.0
Gold,	-	9.0
Sulphur,	-	3.0
Copper,	-	1.3
Silver,	- -	0.5
		100

Klaproth, Beit. b. iii. s. 32.

Geognostic and Geographic Situations.

It is generally associated with yellow tellurium, in veins that traverse porphyry, and has been hitherto found only at Nagyag in Transylvania.

Use.

It is worked for the gold it contains.

Observations.

Its principal characters are colour, lustre, fracture, crystallization, soiling, flexibility, and specific gravity. It is distinguished from *Galena* by its colour, cleavage and flexibility; from *Brittle Silver-glance* and *Copper-glance* by cleavage and flexibility; from *Iron-glance* by softness, sectility, and weight; and from *Graphite* by its slight soiling, and inferior specific gravity.

2. Dr Clarke the celebrated traveller gives a description of the tellurium mines in the fourth volume of his Travels.

3. This mineral was formerly described under the names Graugold (*Or gris*).

GENUS V.

Genus V. MOLYBDENA.

Molydän Glanz, *Mohs.*

This genus contains but one species, viz. Rhomboidal Molybdena.

1. Rhomboidal Molybdena.

Rhomboedrischer Molybdän, *Mohs.*

Wasserblei, *Werner.*

Ferrum Molybdæna pura membranacea nitens, (in part), *Wall.* t. ii. p. 249.—Wasserblei Molybdæna, *Scheele,* i. d. Abhand. d. Schwed. Acad. 1778, s. 238.—Wasserblei, *Werner,* Pabst. b. i. s. 221. *Id. Wid.* s. 962.—Molybdena, *Kirw.* vol. ii. p. 322.—Sulphure de Molybdene, *De Born,* t. ii. p. 119.—Wasserbley, *Emm.* b. ii. s. 541.—Molybene sulphuré, *Lam.* t. i. p. 397. *Id. Haüy,* t. iv. p. 289.—Le Molybdene sulphuré, *Broch.* t. ii. p. 432.—Wasserblei, *Reuss,* b. iv. s. 478. *Id. Lud.* b. i. s. 295.—Molybdankies, *Suck.* 2ter th. s. 437.—Wasserblei, *Bert.* s. 499. *Id. Mohs,* b. iii. s. 588.—Molybdene sulphuré, *Lucas,* p. 179.—Wasserblei, *Leonhard,* Tabel. s. 80.—Molybdene sulphuré, *Brong.* t. ii. p. 92. *Id. Brard,* p. 381.—Molybdän, *Karsten,* Tabel. s. 70.—Molybdänkies, *Haus.* s. 76. —Molybdena, *Kid,* vol. ii. p. 216.—Molybdene sulphuré, *Haüy,* Tabl. p. 114.—Molybdänkies, *Haus.* Handb. b. i. s. 197.—Wasserblei, *Hoff.* b. iv. s. 231.—Molybdena, *Aikin,* p. 133.

External Characters.

Its colour is fresh lead-grey.

It occurs usually massive, disseminated, in plates, also in distinct concretions, which are large, coarse and small granular, and sometimes crystallised.

Its primitive figure is a rhomboid, whose dimensions are unknown. The following are the secondary figures:

1. Regular six-sided table, Pl. 12. fig. 231 *.
2. Very short six-sided prism flatly acuminated on both extremities, with six planes, which are set on the lateral planes, Pl. 12. fig. 232 †.

The crystals are small and middle-sized, and always imbedded, or in druses.

Internally it is splendent, sometimes passing into shining, and the lustre is metallic.

It has a single cleavage, parallel with the lateral planes of the table. The folia of the cleavage are generally curved, and sometimes floriform.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It writes with a bluish-grey streak on paper, but with a greenish-grey streak on porcelain.

It retains its lustre in the streak.

It soils slightly.

It is harder than talc, but not so hard as gypsum.

It is easily frangible.

It splits easily.

In thin leaves it is flexible, but not elastic.

It is sectile, approaching to malleable.

It feels greasy.

Specific gravity 4.4, 4.6, *Mohs*; 4.569, *Karsten*; 4.667, *Schumacher*.

* Molybdene sulphuré prismatique, Haüy.

† Molybdene sulphuré trihexaedre, Haüy.

Chemical Characters.

It gives out a sulphureous odour before the blowpipe; and when urged by the utmost force of the heat, it gives out white vapour, and a pale blue flame; it is soluble, with violent effervescence, in carbonate of soda.

Constituent Parts.

Molybdena,	-	60
Sulphur,	-	40
		100

Bucholz in Gehlen's Journ. de Chem. u. Phys. b. iv. s. 603.

Geognostic Situation.

It occurs disseminated in granite, gneiss, mica-slate, and chlorite-slate, or in veins traversing these rocks, in which it is associated with wolfram, tungsten, tinstone, magnetic iron-ore, arsenical pyrites, fluor-spar, topaz, quartz and heavy-spar.

Geographic Situation.

Europe.—It occurs imbedded in chlorite-slate along with actynolite in Glenelg in Inverness-shire; in granite at Peterhead; in six-sided tables, in quartz in granite, on the mountain of Corybuy, at the head of Loch Creran; in tin and copper veins in Drakewalls mine near Calstock in Cornwall; near Menbilly and in Huel Unity, and Huel Gorland, in veins traversing clay-slate and mica-slate; in granite near the source of the Caldew, about four miles south-west from Hesket Newmarket, Caldbeck Cumberland,

Cumberland, accompanied by apatite and iron, and arsenical pyrites; in granite at Shap in Cumberland. In Norway and Sweden, it is found imbedded in granite and gneiss; in Bohemia and Saxony in veins accompanied with tinstone; in the *Snow-pits* in the Riesengebirge in Silesia, disseminated in granite; in the country of Glatz, imbedded in gneiss and mica-slate; in porphyritic syenite near the copper-mines of Chessy in the department of the Rhone in France; and in granitic rocks in the Alps and the Vosges.

Asia.—Siberia.

America.—In South Carolina; in Virginia; near Baltimore in Maryland, in granite; in Pennsylvania; New York; Connecticut; at Brunswick disseminated in granite, and in gneiss*.

Observations.

1. This mineral has frequently been confounded with *Graphite;* but the following characters sufficiently distinguish them from one another: The colour of graphite is steel-grey, inclining more or less to iron-black; whereas that of molybdena is lead-grey: if both minerals are rubbed on a piece of white porcelain, it will be seen that the streak made by the graphite is of the same colour with the substance by which it was made, while that made by the molybdena is greenish-grey: and graphite soils strongly, but molybdena only slightly.

2. It was formerly considered as a variety of graphite, until Cronstedt and Wallerius described it as a distinct species.

* Cleaveland's Mineralogy.

* Molybdena-Ochre.

Molybdänocher, *Karsten.*

Molybdänocher, *Karsten*, Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 336.

External Characters.

Its colour is sulphur-yellow, which passes on the one side into straw-yellow and orange-yellow, and on the other into siskin-green.

It occurs disseminated, and incrusting molybdena.

It is friable.

It is dull.

Geographic Situation.

It is found investing and intermixed with molybdena, in the granite of Corybuy at Loch Creran; and also at Nummedalen in Norway.

GENUS VI. GOLD-GLANCE.

This genus contains one species, viz. Prismatic Gold-Glance.

1. Prismatic

1. Prismatic Gold-Glance.

Prismatischer Gold-Glanz, *Mohs*.

This Species is divided into two subspecies, viz. Graphic Gold-Glance, and Yellow Gold-Glance.

First Subspecies.

Graphic Gold-Glance, or Graphic Tellurium.

Schrifterz, *Werner*.

Weiss Golderz, *Wid.* s. 673.—Schrifterz, *Esmark*, N. Bergm. Journ. t. ii. p. 10.—Or blanc d'Offenbanya, ou graphique, Aurum graphicum, *De Born*, t. ii. p. 470.—Schrifterz, *Emm.* b. iii. s. 405.—Tellure natif graphique, *Haüy*, t. iv. p. 327.—Le Silvane graphique, *Broch.* t. ii. p. 482.—Schrifterz, *Reuss*, b. iv. s. 608. *Id. Lud.* b. i. s. 310. *Id. Suck* 2ter th. s. 493. *Id. Mohs*, b. iii. s. 65.—Tellure natif aurifere et argentifere, *Lucas*, p. 186.—Schrifterz, *Leonhard*, Tabel. s. 80.—Tellur natif graphique, *Brong.* t. ii. p. 123.—Schrifterz, *Karsten*, Tabel. s. 70.—Schrift Tellur, *Haus.* s. 70.—Tellur natif auro-argentifere, *Haüy*, Tabl. p. 119.—Schrifterz, *Haus.* Handb. b. i. s. 130. *Id. Hoff.* b. iv. s. 129.—Graphic Tellurium, *Aikin*, p. 140.

External Characters.

Its colour is steel-grey, which sometimes becomes white, yellow, or lead-grey, or variously tarnished by exposure to the air.

It occurs massive, disseminated, in leaves; and crystallised.

Its

Its primitive form is an oblique four-sided prism, whose dimensions are unknown.

Several varieties of this prism are enumerated by authors.

The crystals are small, and very small, and are generally arranged in rows on the surface of quartz.

Frequently there are attached to the extremities of the prisms, others at right angles, giving to the whole row the appearance of a line of Persepolitan characters.

The planes of the crystals are smooth.

Externally it is splendent, and the lustre is metallic.

Internally it is glistening, and the lustre is metallic.

Its cleavage is prismatic, and not axifrangible.

The fracture is fine-grained uneven.

It is sometimes as hard as gypsum, and is therefore harder than black tellurium.

It is rather brittle, and easily frangible.

It soils slightly.

Specific gravity 5.7, 5.8, *Mohs.* 5.723, *Müller.*

Chemical Characters.

Before the blowpipe it burns with a green flame, and is volatilized.

Constituent Parts.

Tellurium, -	60
Gold, -	30
Silver, - -	10
	100

Klaproth, Beit. b. iii. s. 20.

Geognostic

Geognostic Situation.

It occurs in veins in porphyry, along with quartz, calcareous-spar, iron-pyrites, blende, and brass-yellow native gold.

Geographic Situation.

It has been hitherto only found at Offenbanya in Transylvania.

Use.

It is worked as an ore of gold, and as an ore of silver.

Observation.

Its name is derived from the particular appearance formed by the aggregation of the crystals.

Second Subspecies.

Yellow Gold-Glance, or Yellow Tellurium.

Weiss Sylvanerz, *Werner.*

Var. de Nagyagerz, *Wid.* s. 671.—Or gris jaunâtre, *De Born,* t. ii. p. 464.—Var. de Nagyagerz, *Emm.* b. i. s. 121.—Mine jaune de Nagyag, *Journ. des Min.* N° 38. p. 150.—Gelberz, *Karst.* Tabel. s. 56.—Tellure natif aurifere et plombifere, *Haüy,* t. iv. p. 327.—Le Silvane blanc, *Broch.* t. ii. p. 484.—Gelberz, *Reuss,* b. iv. s. 612.—Gelbtellurerz, *Lud.* b. i. s. 311. *Id. Suck.* 2ter th. s. 495.—Weiss-sylvanerz, *Bert.* s. 521. *Id. Mohs,* b. iii. s. 59.—Tellure aurifere et plombifere, *Lucas,* p. 186.—Weiss Tellurerz, *Leonhard,* Tabel. s. 80.—Tellure natif

natif plombifere, *Brong.* t. ii. p. 124. *Id. Brard,* p. 392.—Gelberz, *Karsten,* Tabel. s. 70.—Weiss Tellur, *Haus.* s. 71.—Tellure natif auro-plombifere, *Haüy,* Tabl. p. 119.—Weiss Tellur, *Haus.* Handb. b. . s. 131.—Weiss Sylvan, *Hoff.* b. iv. s. 131.—Yellow Tellurium, *Aikin,* p. 140.

External Characters.

Its colour is silver-white, which inclines very much to brass-yellow. It occasionally exhibits a yellow and green play of colour, which, however, is not of long duration, as the whole surface soon becomes of one tint of colour.

It occurs disseminated, less frequently massive, very rarely imperfectly reticulated; and seldom crystallised, in broad four-sided prisms, which are generally acicular.

Externally it is splendent and shining.

Internally it alternates from splendent to glistening, and the lustre is metallic.

The cleavage is prismatic.

The fracture is small-grained uneven.

Specific gravity 5.7, 5.8, *Mohs.*

In other characters agrees with the preceding.

Constituent Parts.

Tellurium,	44.75
Gold,	26.75
Lead,	19.50
Silver,	8.50
Sulphur,	0.50
	100

Klaproth, Beit. b. iii. s. 25.

Geognostic

Geognostic and Geographic Situations.

This mineral occurs in small and very irregular veins in porphyry. The most frequent vein-stones are brown-spar and quartz; sometimes it is also associated with read manganese, sulphuret of manganese, native arsenic, plumose antimony, and brass-yellow native gold. It has been hitherto found only at Nagyag in Transylvania.

Use.

As it contains a considerable portion of gold and silver, it is worked on account of both these metals.

GENUS VII.—BISMUTH-GLANCE.

This genus contains two species, viz. Acicular Bismuth-Glance, and Prismatic Bismuth-Glance. * Cupreous Bismuth. ** Bismuth-Ochre.

1. Acicular Bismuth-Glance.

Nadelförmiger Wismuth-Glanz, *Mohs.*

Nadelerz, *Werner.*

Nadelerz, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 75.—Bismuth sulphuré plumbo-cuprifere, *Haüy,* Tabl. p. 108.—Nadelerz, *Haus.* Handb. b. i. s. 186. *Id. Hoff.* b. iv. s. 282.—Plumbo-cupriferous Sulphureted Bismuth, *Aikin,* p. 122.

External Characters.

Its colour is dark lead-grey.

It

It acquires a bright copper-red tarnish.

It occurs disseminated and crystallised in oblique four or six sided prisms, in which the lateral planes are deeply longitudinally streaked. The crystals are long, often acicular, frequently curved, and sometimes divided by cross rents.

Internally it is splendent in the cleavage; but only shining on the uneven fracture; and the lustre is metallic.

It has an imperfect cleavage.

The fracture is small-grained uneven.

It is opaque.

It is brittle.

It is as hard as gypsum, sometimes even harder; but never so hard as calcareous-spar.

Specific gravity, 6.1, 6.2, *Mohs*; 6.125, *John*.

Chemical Characters.

It is fusible before the blowpipe into a steel-grey globule; by continuance of the heat, it partly volatilises, and deposits on the charcoal a yellow powder, after which there remains a red globule, inclosing a grain of cupriferous metallic lead, which, when treated with glass of borax, communicates a bluish-green colour to it.

Constituent Parts.

Bismuth,	-	-	43.20
Lead,	-	-	24.32
Copper,	-	-	12.10
Sulphur,	-	-	11.58
Nickel,	-	-	1.58
Tellurium,	-	-	1.32
Gold,	-	-	0.79
			94.89

John, n. Chem. Untersuchungen, s. 216.

Or

Or we may estimate its ingredients in the following manner:

Sulphuret of Bismuth,	Bismuth,	43.20	50.76
	Sulphur,	7.56	
Sulphuret of Lead,	Lead,	24.32	28.07
	Sulphur,	3.75	
Sulphuret of Copper,	Copper,	12.10	15.13
	Sulphur,	3.03	
Nickel,	-	-	1.58
Tellurium,	-	-	1.32
Gold,	-	-	0.79

Geognostic Situation.

It occurs imbedded in quartz, and is associated with galena or lead-glance, and native gold. The crystals are sometimes invested with a greenish crust, which appears to be copper-green, and sometimes with a yellow crust of bismuth-ochre.

Geographic Situation.

It occurs in the mines of Pyschminskoi and of Klintzefskoi near Beresof, in the district of Catharinenburg in Siberia.

Observations.

In the former edition of this work, Needle-ore, on the authority of Werner, was arranged as an ore of Chrome; but the late investigations of John have proved, that it belongs to the genus Bismuth-glance. It was at one time considered as an auriferous ore of nickel; and Patrin, so early as the year 1786, approached very near to its true nature, for he describes it as a sulphuret of bismuth.

2. Prismatic

2. Prismatic Bismuth-Glance.

Prismatischer Wismuth-Glanz, *Mohs.*

Wismuth-Glanz, *Werner.*

Galena Wismuthi, *Wall.* t. ii. p. 206.—Minera Wismuthi cinerea-versicolor-martialis, *Id.* p. 207. and 208.—Wismuthglanz, *Wern.* Pabst. b. i. s. 187. *Id. Wid.* s. 890.—Sulphurated Bismuth, *Kirw.* vol. ii. p. 266.—Bismuth sulphuré, *De Born,* t. ii. p. 217.—Wismuth-glanz, *Emm.* b. ii. s. 438.—Bismuth sulphuré, *Lam.* t. ii. p. 333. *Id. Haüy,* t. iv. p. 190.—La Galena de Bismuth, ou le Bismuth sulphuré, *Broch.* t. ii. p. 346.—Wismuth-glanz, *Reuss,* b. iv. s. 314. *Id. Lud.* b. i. s. 271. *Id. Suck.* 2ter th. s. 363. *Id. Bert.* s. 473. *Id. Mohs,* b. iii. s. 631.—Bismuth sulphuré, *Lucas,* p. 157.—Wismuth-glanz, *Leonhard,* Tabel. s. 77.—Bismuth sulphuré, *Brong.* t. ii. p. 133. *Id. Brard,* p. 350.—Wismuth-glanz, *Karsten,* Tabel. s. 70. *Id. Haus.* s. 75.—Bismuth sulphuré, *Haüy,* Tabl. p. 105.—Wismuthglanz, *Haus.* Handb. b. i. s. 190. *Id. Hoff.* b. iv. s. 68.—Sulphureted Bismuth, *Aikin,* p. 121.

External Characters.

Its colour is pale lead-grey.

Externally it is tarnished yellow, or with variegated colours.

It occurs massive, disseminated, in large and coarse granular and narrow radiated concretions, and crystallised.

Its primitive figure is an oblique four-sided prism, the dimensions of which are unknown. The crystals generally met with, are acicular and capillary oblique four and six sided prisms.

Internally

Internally it is splendent and metallic.

The cleavages are parallel to the sides and to the short diagonal of the oblique four-sided prism.

The fragments are indeterminate angular.

It is sometimes harder than gypsum, but never so hard as calcareous-spar.

It soils.

It is brittle, inclining to sectile.

It is easily frangible.

Specific gravity, 6.1, 6.4, *Mohs*; 6.4672, *Brisson*; 6.131, *Kirwan*.

Chemical Characters.

It melts in the flame of a candle. It is volatilised before the blowpipe, and deposits on the charcoal a yellow crust, which becomes white on cooling.

Constituent Parts.

Bismuth,	-	60
Sulphur,	- -	40
		100

Sage in Mem de l'Acad. d. Sc. 1782, p. 307.

Geognostic Situation.

It occurs in veins, and is usually accompanied with native bismuth, grey cobalt, cerite, sparry iron, arsenical-pyrites, copper-pyrites, tinstone, quartz, and fluor-spar.

Geographic Situation.

It is found in Herland-mine, also at Huel Sparnor, near Redruth, and at Botallack, in Cornwall; at Joachimsthall and

and Schlackenwald in Bohemia; Johanngeorgenstadt and Altenberg in the kingdom of Saxony; and Bastnäs near Riddarhytta in Sweden.

Observations.

1. It is distinguished from *Grey Antimony* by its lighter lead-grey colour, and its greater specific gravity; from *Grey Copper* and *Iron-glance*, by colour, and from *Native Bismuth*, by colour.

2. It is a rare mineral.

* Cupreous Bismuth, or Cupriferous sulphureted Bismuth.

Kupferwismutherz, *Karsten*.

Kupferwismuth, *Karsten*, Tabel. s. 70. *Id. Haus.* s. 75. *Id. Klaproth*, Beit. b. iv. s. 91. *Id. Selb*, in d. Annal. der Wetterauischen Gesellch. b. i. s. 40. *Id. Haus.* Handb. b. i. s. 189. —Cupriferous Sulphureted Bismuth, *Aikin*, p. 222.

External Characters.

Its colour is light lead-grey, which passes on the one side into steel-grey, and on the other into tin-white; and its tarnish is yellowish or reddish.

It occurs massive, disseminated, seldom in small scopiformly aggregated prisms.

Internally it is shining and metallic.

The fracture is fine-grained uneven, and sometimes inclines to radiated.

It is sectile.

Constituent Parts.

Bismuth,	- -	47.24
Copper,	- -	34.66
Sulphur,	- -	12.58
		94.48

Klaproth, Beit. b. iv. s. 96.

Or probably more correctly, according to estimation,

Sulphuret of Bismuth,	Bismuth,	47.240	55.507
	Sulphur,	8.267	
Sulphuret of Copper,	Copper,	34.660	43.325
	Sulphur,	8.665	
			98.832

Hausmann, Handb. b. i. s. 188.

Geognostic and Geographic Situations.

It occurs in veins in granite, along with native bismuth, copper-pyrites, and heavy-spar, in the mines named Neuglück, and Daniel at Gallenbach, near Wittichen, in Furstemberg.

Observation.

This rare ore was first discovered by Mr Selb.

Bismuth-Ochre.

Wismuthocker, *Werner.*

Ochra Wismuthi, *Wall.* t. ii. p. 209.—Wismuthocker, *Werner*, Pabst. b. i. s. 188. *Id. Wid.* s. 891.—Bismuth-Ochre, *Kirw.* vol. ii. p. 265.—Ocre de Bismuth, *De Born*, t. ii. p. 194.—Wismuth-ocre, *Emm.* b. ii. s. 440.—Oxide de Bismuth, *Lam.* t. i. p. 332.—Bismuth oxidé, *Haüy*, t. iv. p. 194, 195.—L'Ocre

L'Ocre de Bismuth, *Broch.* t. ii. p. 348.—Wismuth-Ochre, *Reuss*, b. iv. s. 318. *Id. Lud.* b. i. s. 272. *Id. Suck.* 2ter th. s. 364. *Id. Bert.* s. 474. *Id. Mohs*, b. iii. s. 662. *Id. Leonhard*, Tabel. s. 77.—Bismuth oxidé, *Brong.* t. ii. p. 134.—Wismuth-Ochre, *Karsten*, Tabel. s. 70.—Bismuth oxidé, *Haüy*, Tabl. p. 106.—Wismuth-Ocker, *Haus.* Handb. b. i. s. 337.—Native Oxide of Bismuth, *Kid*, vol. ii. p. 212.—Wismuth-ocker, *Hoff.* b. iv. s. 71.—Bismuth Ochre, *Aikin*, p. 122.

External Characters.

Its colour is straw-yellow, which sometimes passes into light yellowish-grey and ash-grey; sometimes even verges on siskin and apple-green *.

It occurs massive and disseminated.

Internally it is glimmering and glistening, and the lustre inclines to adamantine.

The fracture is fine and small-grained uneven, and earthy.

The fragments are indeterminate angular, and rather blunt-edged.

It is opaqué.

It is soft and very soft, verging on friable.

It is rather brittle.

It is easily frangible.

Specific gravity 4.3711, *Brisson.*

Chemical Characters.

Before the blowpipe, on charcoal, it is easily reduced, but it is also volatilised if the heat be continued. It dissolves

* The apple-green varieties contain nickel.

solves with effervescence in acids, and the solution is decomposed by means of water, when a white precipitate is formed.

Constituent Parts.

Oxide of Bismuth,		-	86.3
Oxide of Iron,	-	-	5.2
Carbonic Acid,	-	-	4.1
Water, -	-	-	3.4
			99.0

Lampadius, Handb. z. Chem. Annal. s. 286.

Geognostic and Geographic Situations.

It occurs along with red cobalt, copper-nickel, grey copper, copper-glance or vitreous copper-ore, blue copper, sparry iron, quartz, and calcareous-spar.

It is found at St Agnes in Cornwall; Schneeberg and Johanngeorgenstadt in Saxony; and Joachimsthal in Bohemia; but is a rare mineral.

Observation.

It has been confounded with green iron-earth, from which it is well distinguished not only by its external aspect, but by its accompanying minerals.

Genus VIII.—ANTIMONY-GLANCE.

Spiesglas-Glanz, *Mohs.*

This genus contains three species, viz. Prismatoidal Antimony-Glance, Axifrangible Antimony-Glance, and Prismatic Antimony-Glance. * Antimony-Ochre. ** Nickeliferous Grey Antimony.

1. Prismatoidal Antimony-Glance, or Grey Antimony.

Grau Spiesglaserz, *Werner.*

Prismatoidescher Spiesglas Glanz, *Mohs.*

This species is divided into two subspecies, viz. Common Grey Antimony, and Plumose Antimony.

First Subspecies.

Common Grey Antimony.

Gemeines Grau Spiesglaserz, *Werner.*

This subspecies is divided into three kinds, viz. Common, Foliated, and Radiated.

First Kind.

Compact Grey Antimony.

Dichtes Grauspiesglaserz, *Werner.*

Minera Antimonii solida, *Wall.* t. ii. p. 198.—Dichter Grauspiesglaserz, *Werner,* Pabst. b. i. s. 197. *Id. Wid.* s. 912.—Compact

pact sulphurated Antimony, *Kirw.* vol. ii. p. 247.—Dichter Grauspiesglaserz, *Emm.* b. ii. s. 468.—L'Antimoine gris compacte, *Broch.* t. ii. p. 372.—Dichter Grauspiesglanzerz, *Reuss*, b. iv. s. 367. *Id. Lud.* b. i. s. 278. *Id. Suck.* 2ter th. s. 384. *Id. Bert.* s. 475. *Id. Mohs,* b. iii. s. 687. *Id. Leonhard,* Tabel. s. 79.—Antimoine sulphuré pure compacte, *Brong.* t. ii. p. 127.—Dichtes Grauspiesglanzerz, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 75.—Sulphuret of Antimony, *Kid,* vol. ii. p. 201. —Antimoine sulphuré compacte, *Haüy,* Tabl. p. 113.—Dichtes Grauspiesglazerz, *Haus.* Handb. b. i. s. 194. *Id. Hoff.* b. iv. s. 109.—Antimoine sulphuré compacte, *Haüy,* Tabl. p. 113.—Grey Antimony, *Aikin,* p. 123.

External Characters.

Its colour is light lead-grey, and it has sometimes a pavonine or steel-coloured tarnish.

It occurs massive, disseminated, and seldom in membranes.

Internally, it is shining and glistening, and the lustre is metallic.

The fracture is small and fine-grained uneven, which latter sometimes passes into even.

The fragments are indeterminate angular, and blunt-edged.

It is soft.

It is easily frangible.

It soils.

The lustre is increased in the streak.

Specific gravity, 4.0,—4.6, *Mohs*; 4.368, *Kirwan.*

Geographic Situation.

Europe.—It is found in Huel Boys mine in Cornwall; at Sahlberg in Sweden; Braunsdorf near Freyberg in Saxony;

ony; Hungary; Baireuth; Salzburg; and Auvergne in France.

Asia.—Siberia.

America.—Chili.

Observations.

1. It is distinguished from *White Silver*, *Compact Galena*, and *Copper-Glance*, by colour and specific gravity.

2. It is the rarest subspecies of grey antimony.

Second Kind.

Foliated Grey Antimony.

Blättriges Grauspiesglaserz, *Werner.*

Id. Wern. Pabst. b. i. s. 197.—Foliated sulphurated Antimony, *Kirw.* vol. ii. p. 248.—Blättriches Grauspiesglaserz, *Emm.* b. ii. s. 470.—L'Antimoine gris lamelleux, *Broch.* t. ii. p. 373. —Blättriches Grauspiesglanserz, *Reuss,* b. iv. s. 368. *Id. Lud.* b. i. s. 278. *Id. Suck.* 2ter th. s. 385. *Id. Bert.* s. 475. *Id. Mohs,* b. iii. s. 687. *Id. Leonhard,* Tabel. s. 79.—Antimoine sulphuré pure lamelleux, *Brong.* t. ii. p. 127.—Blättriches Grauspiesglaserz, *Karsten,* Tabel. s. 72. *Id. Haus.* Handb. b. i. s. 194. *Id. Hoff.* b. iv. s. 107.

External Characters.

The colour is the same as that of the preceding kind.

It occurs massive and disseminated; also in coarse, small and fine, generally longish, granular concretions.

Internally it is shining or glistening, and the lustre is metallic.

The cleavage is prismatic.

The

The fragments are indeterminate angular, and not particularly sharp-edged.

It is as hard as gypsum.

It is not particularly brittle.

It is easily frangible.

Specific gravity, 4.0,—4.6, *Mohs*; 4.368, *Kirwan*; 4.300 to 4.382, *Breithaupt.*

Third Kind.

Radiated Grey Antimony.

Strahliches Grauspiesglaserz, *Werner.*

Id. Werner, Pabst. b. i. s. 198. *Id. Wid.* s. 914.—Striated sulphurated Antimony, *Kirw.* vol. ii. p. 249.—Strahliches Grauspiesglaserz, *Emm,* b. ii. s. 374.—L'Antimoine gris rayonné, *Broch.* t. ii. p. 374.—Strahliches Grauspiesglaserz, *Reuss,* b. iv. s. 370. *Id. Lud.* b. ii. s. 279. *Id. Mohs,* b. iii. s. 690. *Id. Leonhard,* Tabel. s. 79.—Antimoine sulphuré pure rayonné, *Brong.* t. ii. p. 127.—Strahliges Grauspiesglanserz, *Karsten,* Tabel. s. 72. *Id. Haus.* s. 75. *Id. Hoff.* b. iv. s. 103.

External Characters.

The colour is common lead-grey, and it is sometimes tarnished with an azure-blue colour, or it exhibits the colours of tempered steel, or it is pavonine.

It occurs massive, disseminated, in distinct concretions, which are scopiform or stellular, or promiscuous radiated, sometimes passing into fibrous, or collected into others of a wedge-shape. It is frequently crystallised, and the primitive

tive figure is an oblique four-sided prism, the dimensions of which are unknown. The following are the secondary figures:

1. Oblique four-sided prism, rather acutely acuminated with four planes, which are set on the lateral planes, Pl. 12. fig. 233. Sometimes the obtuse lateral edges of the prism are truncated, sometimes bevelled, or even rounded off, so that the prism appears reed-shaped.
2. Oblique four-sided prism, flatly acuminated with four planes, which are set on the lateral planes, Pl. 12. fig. 234.
3. Oblique four-sided prism, rather acutely acuminated with four planes, which are set on the lateral planes; and this acumination flatly acuminated with four planes, which are set on the planes of the first acumination, Pl. 12. fig. 235.
4. Oblique four-sided prism, rather acutely acuminated with four planes, which are set on the lateral planes; and the angles formed by the meeting of the acuminating and lateral planes bevelled, Pl. 12. fig. 236.
5. Broad six-sided prism, rather acutely acuminated on the extremities with four planes, which are set on the narrow lateral planes, Pl. 12. fig. 237.
6. Broad six-sided prism, flatly acuminated on both extremities with four planes, which are set on the narrow lateral planes, Pl. 12. fig. 238.
7. In acicular, and sometimes in capillary crystals.

The crystals usually intersect one another, or are scopiformly aggregated. Their surface is strongly longitudinally streaked, and usually shining.

Internally

Internally, it alternates from splendent to glistening, and the lustre is metallic.

The fragments are usually indeterminate angular, and not particularly sharp-edged; sometimes also splintery.

It is as hard as gypsum.

It is rather brittle.

It is easily frangible.

Specific gravity, 4.0—4.6, *Mohs*; 4.200, *Bergman*; 4.229, *Gellert*; 4.1327 to 4.5165, *Brisson*; 4.440, *Kirwan*.

Chemical Characters.

It melts by the mere flame of a candle; it is almost entirely dissipated before the blowpipe, in the form of a white vapour, with a sulphureous odour.

Constituent Parts.

Antimony, -	74	75
Sulphur, -	26	25
	100	100
	Bergman, Chem. Opusc. t. ii. p. 167.	*Proust*.

Geognostic Situations of the Foliated and Radiated Kinds.

These minerals occur in veins, and it is said sometimes also in beds, in primitive and transition mountains. The veins sometimes contain no other minerals besides antimony and quartz; in other instances they are associated with gold, or ores of silver, and more frequently with galena or lead-glance, grey copper, iron-pyrites, arsenical-pyrites, blende, heavy-spar and brown-spar.

Geographic

Geographic Situation.

Europe.—It occurs at Glendinning in Dumfriesshire, in veins that traverse transition rocks, accompanied with fine granular brown blende, iron-pyrites, quartz, and calcareous-spar *; it has been lately discovered in Banffshire; in Cornwall at St Stephens, Padstow, and Huel Boys in Endellion, in veins traversing those of copper and tin-ore, but not in the east and west veins of that county; at Narverud and Hillebeck near Eger in Norway, along with common garnet; in veins in transition rocks in the Hartz; in veins that traverse gneiss in Massiac and Langle in Auvergne: at Braunsdorf in Saxony; in Bohemia, Silesia, Swabia, Salzburg, Tuscany, Sardinia, Corsica, Sicily, and Spain; also at Offenbanya in Hungary, in veins with galena, grey copper, iron-pyrites, and brown blende, in foliated granular limestone; at Felsobania in Transylvania, associated with grey copper, plumose antimony, red orpiment, red antimony, rose-red brown-spar, calcareous-spar and quartz.

America.—It is found at Catorce and Los Pozuelos, near Guencamé in Mexico; also in Louisiana †, Connecticut, Massachusets and Maine ‡.

Second Subspecies.

Plumose Grey Antimony.

Federerz, *Werner.*

Minera Antimonii plumosa, *Wall.* t. ii. p. 197.—Federerz, *Wern.* Pabst. b. i. s. 201. *Id. Wid.* s. 916.—Plumose Antimonial ore,

* Jameson's Mineralogy of Dumfriesshire, p. 74.

† Bruce's American Mineralogical Journal, p. 125.

‡ Cleaveland's Mineralogy, p. 563.

ore, *Kirw.* vol. ii. p. 250.—Federerz, *Emm.* b. ii. s. 474.—L'Antimoine en plumes, *Broch.* t. ii. p. 377.—Haarförmiges, Grauspiesglanzerz, *Reuss,* b. iv. s. 375.—Federerz, *Lud.* b. i. s. 280. *Id. Suck.* 2ter th. s. 389. *Id. Bert.* s. 478. *Id. Mohs,* b. iii. s. 702.—Haarförmiges Grauspiesglanzerz, *Leonhard,* Tabel. s. 79.—Antimoine sulphuré capillaire, *Brong.* t. ii. p. 127.—Haarförmiges Grauspiesglanzerz, *Karsten,* Tabel. s. 72.—Federerz, *Haus.* s. 75.—Antimoine sulphuré capillaire, *Haüy,* Tabl. p. 113.—Federerz, *Hoff.* b. iv. s. 110. *Id. Haus.* Handb., b. i. s. 196.—Plumose Grey Antimony, *Aikin,* p. 124.

External Characters.

Its colour is intermediate between dark lead-grey and smoke-grey. The lighter coloured varieties have sometimes a tempered steel coloured tarnish.

It occurs sometimes massive; most commonly, however, in thin capillary crystals, which are almost always promiscuously or scopiformly aggregated, and sometimes so interwoven as to appear like wool.

Externally the crystals are glistening.

Internally it is glimmering, and the lustre is semi-metallic or metallic.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

It is very soft, passing into friable.

It is rather brittle, and easily frangible.

Chemical Characters.

Before the blowpipe, it melts into a black slag, after giving out a vapour, which, when condensed, appears in form of a white and yellow powder.

Constituent

Constituent Parts.

According to Bergman, it is a compound of Antimony, Sulphur, Arsenic, Iron and Silver. Some mineralogists, as Cronstadt, from its containing silver, refer it to the ores of silver.

Geognostic Situation.

It occurs most frequently in veins in primitive rocks, that contain ores of silver, particularly white silver; also in antimony veins. It is usually accompanied with argentiferous arsenical-pyrites, native tellurium, and the ores already mentioned as accompanying the other ores of this metal. A newer formation is met with in transition rocks, where it is associated with galena or lead-glance, grey copper, sparry iron, and fluor-spar.

Geographic Situation.

Europe.—It occurs at Andreasberg and Clausthal in the Hartz; Freyberg and Braunsdorf in the kingdom of Saxony; Rathhausberg in Gastein, and Schwarzleogang in Salzburg; Schemnitz in Hungary; Nagyag and Felsobanya in Transylvania.

America.—Mexico.

Observations.

1. It is distinguished from *Amianthus* and *Tremolite* by its colour, kind of lustre, and easier fusibility.

2. It has been described under the name *Silberfederez.*

2. Axifrangible

2. Axifrangible Antimony Glance, or Bournonite.

Axentheilender Spiesglas, *Mohs.*

Schwarzspies Glanzerz, *Werner.*

Spiessglanzbleierz, *Karsten.*

Hatchett and *Bournon,* in Phil. Trans. for 1804.—Spiessglanzblei, *Karsten,* Tabel. s. 68.—Plomb sulphuré antimonifere, *Haüy,* Tabl. p. 80.—Triple sulphuré d'Antimoine, Plomb et Cuivre, Endellione, *Bournon,* Catalogue Mineralogique, p. 409.—Spiessglanzbleierz, *Haus.* Handb. b. i. s. 173.—Schwarz Spiesglanzerz, *Hoff.* b. iv. s. 111.—Triple Sulphuret of Lead, *Aikin,* p. 109.

External Characters.

Its colour is blackish lead-grey, falling into steel-grey.

It generally occurs massive, disseminated, and crystallised.

Its primitive form is an oblique four-sided prism, the angles of which are unknown. This prism occurs variously modified by truncation, and bevelment on the edges and terminal planes, and by acuminations on the terminal planes.

Externally it is shining and metallic.

Internally the lustre is intermediate between glistening and glimmering, and is metallic.

It cleavage is axifrangible.

The fracture is small, and rather perfect conchoidal, and rarely coarse-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It is harder than gypsum, but not so hard as calcareous-spar.

It

It becomes more shining in the streak.

It is brittle, and easily frangible.

Specific gravity, 5.5,—5.8, *Mohs*; 5.700, *Hatchett.*

Chemical Characters.

Before the blowpipe, it generally splits and decrepitates, then melts, emitting a white and sulphureous vapour; after which, there remains a crust of sulphureted lead, inclosing a globule of copper.

Constituent Parts.

	Huel Boys, near Endellion, Cornwall.	Cornwall.	Clausthal.
Lead, -	42.62	39.00	42.50
Antimony, -	24.23	28.50	19.75
Copper, -	12.80	13.50	11.75
Iron, - -	1.20	1.00	5.00
Sulphur, -	17.00	16.00	18.00
	Hatchett, Phil. Trans. 1804, i. 63.	*Klaproth*, Beit. b. iv. s. 90.	Id. s. 86.

According to an estimate of Mr Smithson, this ore contains in 100 parts the following compounds:

Sulphuret of Lead or Galena,	Lead,	41.08	47.41
	Sulphur,	6.33	
Sulphuret of Antimony,	Antimony,	25.67	34.23
	Sulphur,	8.56	
Sulphuret of Copper,	Copper,	12.80	16.00
	Sulphur,	3.20	
Sulphuret of Iron,	Iron,	1.20	2.60
	Sulphur,	1.40	
			100.24

Smithson, Phil. Trans. for 1808, P. i. p. 55. &c.

Geognostic

Geognostic and Geographic Situations.

Europe.—It is found near Endellion in Cornwall, along with grey antimony, and brown-blende, in veins in clay-slate. On the Continent, it is met with at Ratisbon, associated with brown blende, grey copper, galena or lead-glance, and common iron-pyrites; also in Saxony; in the Hartz, accompanied with galena or lead-glance, sparry iron, and heavy-spar, in veins that traverse grey-wacke and grey-wacke-slate; at Bleyberg in Carinthia, and at Kapnic, in Transylvania.

Asia.—In Siberia, along with quartz, malachite, galena or lead-glance, and calcareous-spar.

America.—In Peru, associated with copper and iron pyrites.

Observations.

In a former edition of this work, I named this mineral *Bournonite*, in honour of Bournon, who first described it: Count Bournon names it *Endellione*, from the parish in which it was first found.

3. Prismatic Antimony-Glance.

Prismatischer Spiesglas Glanz, *Mohs.*

External Characters.

Its colour is blackish lead-grey.

Its primitive figure is an oblique four-sided prism, the dimensions of which are unknown.

The lustre is shining and metallic.

Its

Its cleavage is in the direction of the smaller diagonal of the prism.

It is harder than gypsum, and sometimes as hard as calcareous-spar.

Specific gravity 5.7, 5.8, *Mohs.*

Observations.

The above description is that of Mohs, and contains all the information I possess in regard to this species.

* Antimony-Ochre.

Spiesglanzocker, *Werner.*

Spiessglanzocher, *Reuss,* b. ii. s. 388. *Id. Lud.* b. i. s. 282. *Id. Suck.* 2ter th. s. 394. *Id. Bert.* s. 478. *Id. Mohs,* b. iii. s. 713. *Id. Leonhard,* Tabel. s. 79. *Id. Karsten,* Tabel. s. 72.—Antimoine oxydé terreux, *Haüy,* Tabl. p. 113.—Spiessglanzocher, *Haus.* Handb. b. i. s. 339. *Id. Hoff.* b. iv. s. 124.—Antimonial Ochre, *Aikin,* p. 125.

External Characters.

Its colour is straw-yellow, of different degrees of intensity, which inclines on the one side into yellowish-grey, on the other into yellowish-brown.

It sometimes occurs massive, and disseminated, but generally incrusting crystals of grey antimony.

It is dull or glimmering.

The fracture is small-grained uneven or earthy.

It is soft, passing into very soft.

It is rather brittle, and easily frangible.

Chemical Characters.

Before the blowpipe, on charcoal, it becomes white, and evaporates without melting. With borax, it intumesces, and is partly reduced to the metallic state.

Geognostic and Geographic Situations.

It occurs always in veins, and accompanied with grey antimony, and sometimes with red antimony.

It is found at Dublowitz, near Saltschaw in Bohemia; Telkebanya in Hungary; Toplitz in Transylvania; Braunsdorf, in the kingdom of Saxony; on the Sonnenberg, near Mittersill in Salzburg; and in Siberia.

Observations.

It nearly resembles bismuth-glance in external characters, but is readily distinguished from it by its accompanying minerals.

Nickeliferous Grey Antimony.

Antimoine sulphuré nickelifere, *Haüy*.

Id. Lucas, t. ii. p. 471. *Id. Vauquelin,* Annal. du Mus. t. xix. p. 52.—Spiessglanzkies, *Haus.* Handb. b. i. s. 192.—Nickel Antimonerz, *John,* in Scwheigger's Journal for 1814.

External Characters.

Its colour is steel-grey, which passes on the one side into lead-grey, on the other into tin-white, and is tarnished with tempered-steel colours.

It

It occurs massive and disseminated.

It is shining and glistening.

It has a double rectangular cleavage.

The fragments are cubical.

It is harder than grey antimony.

It is brittle.

It is easily frangible.

Specific gravity, 5.65—6.546, *Strohmeyer*; 6.020—6.833, *Ullman*.

Chemical Characters.

On exposure to the blowpipe, it melts, emits a white vapour, having the smell of arsenic, part of which remains attached to the charcoal, to which it communicates a yellow colour. In proportion as the vapours are exhaled, the fusibility is diminished, until the remaining portion becomes infusible: the infusible portion appears as a small white easily frangible button, which proves that at least two metals enter into the composition of this ore.

It is partly soluble in nitric acid, to which it communicates a green colour, and deposites a white powder. It is almost entirely dissolved in muriatic acid.—*Vauquelin.*

Constituent Parts.

It is composed of Antimony, Nickel, Arsenic, Iron, Lead, and Sulphur: of these, the antimony is the most abundant, forming about half of the ore; the next in quantity is the nickel; arsenic the third; sulphur the fourth; iron the fifth; and lead but in very small quantity. It is probable that the antimony and sulphur form a particular combination, the arsenic and nickel another, which is mechanically

chanically mixed with the first, and that the lead and iron are combined with the sulphur.—*Vauquelin.*

According to John, it contains Antimony with Arsenic, 61.68; Nickel, 23.33; Sulphur, 14.16; Silica with Silver and lead, 0.83; Trace of Iron. According to Strohmeyer, 43.80 Antimony; 36.60 Nickel; 17.71 Sulphur; 1.89 Iron and Manganese. According to Ullman, 47.75 Antimony; 25.25 Nickel; 11.75 Arsenic; 15.25 Sulphur.

Geognostic and Geographic Situations.

It occurs in veins near Freussberg, in the county of Sayn-Altenkirchen, in the principality of Nassau, along with sparry iron, galena or lead-glance, and copper-pyrites.

ORDER V.

ORDER V. *BLENDE.*

GENUS I. MANGANESE-BLENDE.

Glanz-Blende, *Mohs.*

Mangan-Blende, *Werner.*

This genus contains but one species, viz. Prismatic Manganese Blende. * Phosphate of Manganese.

1. Prismatic Manganese Blende.

Prismatischer Glanz-Blende, *Mohs.*

Schwarzerz, *Müller v. Reichenstein,* Phys. arb. d. eintr. Fr. i. Wien. 1. Jahrg. 2. Quart. s. 86. *Id. Reuss,* b. ii. 4. s. 446. —Braunsteinkies, *Leonhard,* Tabel. s. 70.—Manganglanz, *Karsten,* Tabel. s. 72.—Manganese sulphuré, *Haüy,* Tabl. p. 111.—Schwarzerz, *Haus.* Handb. b. i. s. 199.—Manganblende, *Hoff.* b. iv. s. 197.—Sulphuret of Manganese, *Aikin,* p. 132.

External Characters.

Its colour on the fresh fracture is iron-black, which approaches to dark steel-grey; but on exposure it becomes tarnished of a brownish-black colour.

It occurs massive, disseminated: in distinct concretions, which are coarse and small granular, and in which the surfaces are marked with interrupted fortification-like streaks. It is sometimes crystallised: its primitive form is an oblique four-sided prism, the dimensions of which are unknown. The prism occurs variously modified by truncation on the lateral edges.

Its

Its lustre is splendent or shining, and semi-metallic.

Its cleavage is prismatic, but is very imperfect.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

Its streak is of a greenish colour.

It is harder than calcareous-spar, and sometimes as hard as fluor-spar.

It is intermediate between sectile and imperfectly brittle, and is easily frangible.

Specific gravity, 3.9, 4.0, *Mohs*; 3.95, *Klaproth*.

Chemical Characters.

Before the blowpipe, it gives out sulphur, and tinges borax violet-blue.

Constituent Parts.

Oxide of Manganese,	82.00	85
Sulphur, -	11.50	15
Carbonic Acid, -	5.00	
	98	100
	Klaproth, Beit. b. iii. s. 42.	*Vauquelin*, Annal. d. Mus. vi. s. 405.

Geognostic and Geographic Situations.

It is found in Cornwall; and at Nagyag in Transylvania, along with ores of tellurium, blende, copper-pyrites, compact red manganese, and brown-spar.

Observations.

1. It is easily distinguished from all metalliferous minerals, having the same colour, by its greenish-grey streak.

 It

It is most nearly allied to *Black Blende*, but is readily distinguished by its streak, and the form of its crystals.

2. It has been described under the following names, Schwarzerz, Braunsteinkies, Magnesiumkies, Braunsteinblende, and Manganglanz.

Phosphate of Manganese.

Eisenpecherz, *Werner*.

Fer phosphaté, *Broch.* t. ii. p. 533.—Manganese phosphaté, *Brong*. t. ii. p. 112.—Phosphormangan, *Karsten*, Tabel. s. 72.—Manganese phosphaté ferrifere, *Haüy*, Tabl. p. 111.—Triplit, *Haus.* Handb. b. iii. s. 1079.—Eisenpecherz, *Hoff.* b. iii. s. 300.—Phosphate of Manganese, *Aikin*, p. 133.

External Characters.

Its colour is brownish-black, sometimes inclining to clove-brown.

It occurs massive and disseminated.

Internally it is shining, glistening, or glimmering, and the lustre is resinous, inclining to adamantine.

Its cleavage is imperfect, and appears to be in the direction of the lateral planes of a prism.

The fracture is imperfect, and flat conchoidal.

It is opaque in the mass, but semi-transparent in splinters.

It scratches glass.

Its streak is yellowish-grey.

It is brittle and easily frangible.

Specific gravity, 3.4890, *Vauquelin*. 3.767, 3.775, *Ullmann*, 3.731, *Karsten*. 3.562, *Breithaupt*.

Chemical

Chemical Characters.

It is readily fusible before the blowpipe into a black enamel.

Constituent Parts.

Oxide of Manganese,	-	42
Oxide of Iron,	-	31
Phosphoric Acid,	-	27
		100

Vauquelin, Journ. d. Min. N. 64. p. 299.

Geognostic and Geographic Situations.

It occurs in a coarse granular granite at Limoges in France; and it is said also in Pennsylvania.

GENUS II.—ZINC-BLENDE OR GARNET-BLENDE *.

Granat-Blende, *Mohs*.

This genus contains one species, viz. Dodecahedral Zinc-Blende.

1. Dodecahedral

* This genus is by Mohs named *Garnet-Blende*, on account of its resemblance to garnet: throughout the present system, it is in general simply named Blende.

1. Dodecahedral Zinc-Blende.

Dodecaedrischer Granat-Blende, *Mohs.*

Blende, *Werner.*

This species is divided into three subspecies, viz. Yellow Zinc-Blende, Brown Zinc-Blende, and Black Zinc-Blende.

First Subspecies.

Yellow Zinc-Blende.

Gelbe Blende, *Werner.*

Id. Wern. Pabst. b. i. s. 188. *Id. Wid.* s. 898.—Yellow Blende, *Kirw.* vol. ii. p. 238.—Gelb Blende, *Emm.* b. ii. s. 443.—La Blende jaune, *Broch.* t. ii. p. 350.—Gelbe Blende, *Reuss,* b. iv. s. 326. *Id. Lud.* b. i. s. 273. *Id. Suck.* 2ter th. s. 367. *Id. Bert.* s. 464. *Id. Mohs,* b. iii. s. 557. *Id. Leonhard,* Tabel. s. 74.—Zinc sulphuré jaune, *Brong.* t. ii. p. 141.—Gelbe Blende, *Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 232. *Id. Hoff.* b. iv. s. 74.—Phosphorescent Blende, *Aikin,* p. 118.

External Characters.

It exhibits the following series of colours: asparagus and oil green, seldom sulphur-yellow, most frequently wax-yellow, which sometimes passes into yellowish-grey, then into lemon, honey, and orange yellow, aurora and hyacinth red, into pale reddish brown, which forms the transition into brown blende. All these colours incline more or less to green.

It occurs usually massive, disseminated, in granular concretions,

concretions, and crystallised in octahedrons, rhomboidal dodecahedrons, and in twin crystals.

The crystals are middle-sized and small, seldom single, generally in druses, but usually so much grown together, that it is difficult to determine their figure.

The crystals have a smooth surface.

Externally and internally it is shining and splendent, and the lustre is adamantine, inclining to resinous.

The cleavage is dodecahedral, that is, it is sixfold, and the folia are parallel with the sides of the dodecahedron.

The fragments are dodecahedral, but on account of the distinct concretions can seldom be obtained perfect, and are therefore most commonly indeterminate angular, and sharp-edged.

It is usually only translucent, but the lighter coloured varieties are semitransparent, inclining to transparent.

It refracts single.

It yields a yellowish-grey or yellowish-white streak.

It is harder than calcareous-spar, and even as hard as fluor-spar.

It is brittle, and easily frangible.

Specific gravity, 4.0, 4.2, *Mohs*; 4.044 to 4.048, *Gellert*; 4.067, *Kirwan*; 4.103, *Karsten*.

Physical Character.

It becomes phosphorescent by friction; and, according to Bergmann, as powerfully under water as in the air.

Chemical Characters.

It decrepitates before the blowpipe, becomes grey, but is infusible either alone or with borax.

Constituent

Constituent Parts.

Yellow Blende from Scharfenberg.		
Zinc, -	64	62.0
Sulphur, -	20	34.0
Iron, -	5	1.5
Fluoric Acid, -	4	
Silica, -	1	
Water, -	6	
	100	97.5
	Bergmann, Opuscul. t. ii. p. 345.	*Gueniveau*, Journ. des Mines, N. 126.

Geognostic Situation.

It occurs in veins in primitive, transition, and flœtz rocks, where it is generally associated with galena or lead-glance.

Geographic Situation.

It occurs along with galena or lead-glance, copper-pyrites, copper-green, red cobalt, and heavy-spar, in veins that traverse quartz-rock, at Clifton Mine, near Tyndrum in Perthshire; also in Flintshire. Very beautiful specimens are met with at Ratieborziz in Bohemia, where it is associated with galena or lead-glance, grey copper, iron-pyrites, brown-spar, and quartz; and sometimes also with native silver, silver-glance or red silver. It is also found at Scharfenberg in Saxony; Rammelsberg in the Hartz, in veins in transition rocks. The green varieties are found at Gumerud in Norway, associated with galena or lead-glance, smalt-blue apatite, in transition rocks; and it is accompanied with manganese-blende and red manganese, at Nagyag in Transylvania.

Observations.

Observations.

It is characterised by its colour, strong adamantine lustre, and high degree of transparency ; the reddish varieties are distinguished from *Red Silver* and from *Cinnabar*, by their distinct cleavage, superior hardness, and inferior weight.

Second Subspecies.

Brown Zinc-Blende.

Braun Blende, *Werner.*

This subspecies is divided into two kinds, viz. Foliated Brown Zinc-Blende, and Fibrous Brown Zinc-Blende.

First Kind.

Foliated Brown Zinc-Blende.

Blättrige Braune Blende, *Werner.*

Id. Werner, Pabst. b. i. s. 191. *Id. Wid.* s. 896.—Brown Blende, *Kirw.* vol. ii. p. 239.—Braune Blende, *Emm.* b. ii. s. 447.—La Blende brune, *Broch.* t. ii. p. 353.—Braune Blende, *Reuss,* b. iv. s. 330. *Id. Lud.* b. i. s. 274. *Id. Suck.* 2ter th. s. 369. *Id. Bert.* s. 466. *Id. Mohs,* b. iii. s. 564. *Id. Leonhard,* Tabel. s. 74.—Zinc sulphuré brun, *Brong.* t. ii. p. 141.—Braune Blende, *Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 231.—Blättrige Braune Blende, *Hoff.* b. iv. s. 78.

External Characters.

Its principal colour is reddish-brown, which passes on the one side into hyacinth-red and yellowish-brown, and on the other into blackish-brown, and rarely into clove-brown.

It

It is sometimes tarnished with variegated colours.

It occurs usually massive, and disseminated, also in granular distinct concretions, varying in magnitude from large to extremely fine granular; often crystallised:

1. Rhomboidal dodecahedron, which may be viewed as the fundamental or primitive figure. It is either perfect or truncated on the alternate lateral edges and angles, with triangular planes.
2. Octahedron, which is sometimes elongated, and is either perfect, truncated on the edges or angles, or on both at once; and sometimes bevelled on the edges.
3. Tetrahedron, which is either perfect or truncated on the angles.
4. Acicular crystals.

The crystals are small, very small, and middle-sized. Their lateral planes are generally convex.

Externally it is drusy and shining.

Internally it alternates from specular splendent to feebly glimmering, and the lustre is intermediate between pearly and adamantine.

The cleavage is sixfold or tessular.

It is more or less translucent, commonly strongly translucent on the edges. The extremely fine granular variety is opaque. The large and coarse granular varieties are translucent, sometimes bordering on perfect transparent.

It yields a yellowish-brown streak.

In other characters, agrees with the preceding.

Specific gravity 4.048, *Gellert*.

Constituent

Constituent Parts.

From Sahlberg.		Allonheads, Northumberland.	
Zinc, -	44	Zinc, -	58.8
Iron, -	5	Sulphur, -	23.5
Sulphur, -	17	Iron, -	8.4
Silica, -	24	Silica, -	7.0
Alumina, -	5		——
Water, -	5		97.7
	——		*Dr Thomson.*
	100		

Bergmann, Opusc. t. ii. p. 332.

Blende, like all other ores, often contains what, chemically considered, may be viewed as accidental ingredients; thus the blende of Prizbram frequently contains silver; and that from Nagyag, manganese, lead, arsenic, and auriferous silver.

Geognostic Situation.

It occurs principally in veins and beds, in primitive and transition rocks; seldomer in secondary or flœtz rocks. It is associated with ores of different kinds, such as galena or lead-glance, copper-pyrites, iron-pyrites, grey copper, and black silver-ore.

Geographic Situation.

It occurs in the Clifton lead-mine near Tyndrum in Perthshire; in small veins along with galena, in the coal-fields around Edinburgh; at Cumberhead in Lanarkshire, along with galena or lead-glance; at Leadhills it is associated with galena, white lead-spar, sulphate of lead, spar-

ry

ry iron, iron-pyrites, brown hematite, blue copper, electric calamine, and wad; the vein-stones are quartz, lamellar heavy-spar, calcareous-spar, brown-spar, and mountain-cork. It is met with in all the lead-mines in England and Wales. On the Continent of Europe it forms a constant attendant of galena or lead-glance, whether it occurs in veins or beds; and it maintains the same relation in the lead-mines of Asia, Africa and America.

Second Kind.

Fibrous Brown Zinc-Blende.

Fasrige Braune Blende, *Werner.*

Hepatisches Zinkerz, *Widemann,* Min. s. 906.—Zink sulphuré compacte, *Broch.* t. ii. p. 359.—Schaalenblende, *Reuss,* b. iv. s. 342. *Id. Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 233.—Fasrige & Strahlige Braune Blende, *Hoff.* b. iv. s. 83, 84.—Fibrous Blende, *Aikin,* p. 119.

External Characters.

Its colour is dark reddish-brown, which passes sometimes into yellowish, seldom into clove brown.

It occurs massive and reniform; also in distinct concretions, which are scopiform and stellular fibrous or radiated, and collected into others, which are granular, and these again traversed by curved lamellar concretions, bent in the direction of the external surface.

It is glistening, passing into strongly glimmering, and the lustre is resinous, inclining to pearly.

It

It is opaque, or very feebly translucent on the edges.

In other characters it agrees with foliated brown blende.

Constituent Parts.

	From the Breisgau.
Zinc, - - - -	62
Iron, - - - -	3
Lead, - - - -	5
Arsenic, - - - -	1
Sulphur, - - - -	21
Alumina, - - - -	2
Water, - - - -	4
	98

Hecht, in Journ. d. Min. t. xlix. N. 13.

Geognostic and Geographic Situations.

It occurs in Huel Unity copper-mine in Cornwall, in small masses, incrusting copper-pyrites, and is sometimes itself covered with sparry-iron; and along with galena and iron pyrites at Geroldsbeck in the Breisgau, and Raibel in Carinthia.

Observations.

1. It bears a considerable resemblance to fibrous brown iron-ore, from which it is principally distinguished by its resinous lustre, and its accompanying minerals.

2. The lamellar variety is described under the name *Schaalenblende*.

Third

Third Subspecies.

Black Zinc-Blende.

Schwarze Blende, *Werner.*

Id. Werner, Pabst. b. i. s. 193. *Id. Wid.* s. 893.—Black Blende, *Kirw.* vol. ii. p. 241.—Schwarze Blende, *Emm.* b. ii. s. 451.—La Blende noire, *Broch.* t. ii. p. 357.—Schwarze Blende, *Reuss,* b. iv. s. 337. *Id. Lud.* b. i. s. 275. *Id. Suck.* 2ter th. s. 371. *Id. Bert.* s. 467. *Id. Mohs,* b. iii. s. 575. *Id. Leonhard,* Tabel. s. 74.—Zinc sulphuré noir, *Brong.* t. ii. p. 141.—Schwarze Blende, *Karsten,* Tabel. s. 70. *Id. Haus.* Handb. b. i. s. 230. *Id. Hoff.* b. iv. s. 86.

External Characters.

Its colour is intermediate between greyish and velvet black; it is rarely of a blood-red colour. It is sometimes tarnished with variegated colours.

It occurs massive, disseminated, in granular distinct concretions, and crystallised in the same figures as brown blende.

The crystals are small; and so much grown together, that it is very difficult to ascertain their figure.

Internally it is shining, sometimes splendent, and the lustre is adamantine, inclining to metallic.

The cleavage is the same as in the other subspecies, but much less distinct.

The fragments are indeterminate angular, and rather sharp-edged.

It is almost always opaque, excepting the blood-red variety, which is translucent on the edges and angles.

 The

The streak is dark yellowish-brown.

Its other characters agree with the preceding.

Specific gravity, 4.1665, *Brisson*; auriferous from Nagyag, according to *Von Müller*; 4.085,—4.108, *Breithaupt*.

Constituent Parts.

	From Danemora.	Bowallon.
Zinc,	45	52
Iron,	9	8
Lead,	6	—
Arsenic,	1	—
Copper,	—	4
Sulphur,	29	26
Silica,	4	6
Water,	6	4
	100	100

Bergman, Opuscul. t. iv. p. 329.

Oxide of Zinc,	53
Iron,	12
Arsenic,	5
Sulphur,	26
Water,	4
	100

Lampadius, Handb. z. Chem. Annal. d. Min. s. 282.

The black blende from Nagyag, besides zinc, iron, and manganese, contains a portion of auriferous silver. The lead and copper obtained from blende by Bergman, were probably derived from very minutely mixed galena or lead-glance and copper-pyrites, and the silica from the vein-stone. In the Freyberg mining district, some varieties of blende, named *Verglaste Blende*, contain a small portion of silver.

Geognostic Situation.

It occurs in veins in gneiss, seldomer in grey wacke. It is generally accompanied with copper-pyrites, arsenical-pyrites,

pyrites, iron-pyrites, magnetic iron-ore, red silver, white silver, and galena. It is rarely associated with brown blende. Its accompanying vein-stones are calcareous-spar, brown-spar, and rarely asbestous actynolite, and garnet.

Geographic Situation.

It occurs in Sweden, Saxony, Silesia, Hungary, Transylvania, and in Mexico.

Uses of the Species.

This ore is valued on account of the zinc which it affords. In order to obtain that metal from it, it is first roasted, to drive off the sulphur, and then ground with charcoal, and exposed to heat in a crucible, when the metal is reduced, and sublimes into a lute, so placed as to convey it into water, when it condenses in small drops.

Observations on the Species.

1. It is distinguished from *Tinstone*, by its inferior hardness: from *Galena* or *Lead-Glance*, by its grey-coloured dull streak; and it is distinguished from most other substances which it resembles, by exhaling a sulphureous odour, when either triturated in a mortar, or thrown into an acid.

2. Of all the subspecies, the brown is the most frequent and abundant.

3. Blende is named *Black Jack* by the miners in England; and is also known under the name *Pseudo-galena*.

GENUS III.

GENUS III.—ANTIMONY-BLENDE.

Nadel-Blende, *Mohs.*

This genus contains one species, viz. Prismatic Antimony-Blende.

1. Prismatic Antimony-Blende, or Red Antimony.

Prismatische Nadel-Blende, *Mohs.*

Rothspiesglaserz, *Werner.*

This species is subdivided into two subspecies, viz. Common Antimony-Blende, and Tinder Antimony-Blende.

First Subspecies.

Common Antimony-Blende, or Common Red Antimony.

Gemeines Rothspiesglaserz, *Werner.*

Minera Antimonii colorata, *Wall.* t. ii. p. 199.—Roth-spiesglaserz, *Werner,* Pabst. b. i. s. 202. *Id. Wid.* s. 918.—Red Antimonial ore, *Kirw.* vol. ii. p. 250.—Rothspiesglaserz, *Emm.* b. ii. s. 477.—Antimoine rougeâtre, mineralisé par le Soufre, *Lam.* t. i. p. 343.—Antimoine hydro-sulphuré, *Haüy,* t. iv. p. 276.—L'Antimoine rouge, *Broch.* t. ii. p. 379.—Rothspiesglanzerz, *Reuss,* b. iv. s. 379. *Id. Lud.* b. i. s. 281. *Id. Suck.* 2ter th. s. 390. *Id. Bert.* s. 480. *Id. Mohs,* b. iii. s. 706.—Antimoine hydro-sulphuré, *Lucas,* p. 174.—Rothspiesglanzerz, *Leonhard,* Tabel. s. 79.—Antimoine hydro-sulphuré capillaire, *Brong.* t. ii. p. 129.—Rothspiesglanzerz, *Karsten,*

Tabel. s. 72. *Id. Haus.* s. 77.—Hydro-sulphuret of Antimony, *Kid,* vol. ii. p. 202.—Antimoine hydro-sulphuré, *Haüy,* Tabl. p. 113.—Rothspiesglanzerz, *Haus.* Handb. b. i. s. 225.—Gemeines Rothspiesglanzerz, *Hoff.* b. iv. s. 115.—Red Antimony, *Aikin,* p. 124.

External Characters.

Its colour is distinct cherry-red, and the surface has sometimes a tempered steel or columbine tarnish.

It occurs massive, disseminated, in flakes; in granular distinct concretions; and also crystallised.

The primitive form is an oblique four-sided prism, the dimensions of which are unknown.

The crystals are generally delicate capillary, and are variously aggregated, as scopiformly, stellularly, and promiscuous.

Externally and internally it is shining, and the lustre is nearly adamantine.

The cleavage is prismatic.

The fragments are wedge-shaped and splintery.

It is opaque, or translucent on the edges.

The colour is not changed in the streak.

It is harder than talc, but not so hard as gypsum.

It is rather brittle, and very easily frangible.

Specific gravity 4.5, 4.6, *Mohs.*

Chemical Characters.

It melts and evaporates before the blowpipe, giving out a sulphureous odour.

Constituent

Constituent Parts.

From the mine called Neue Hoffnung Gottes at Braünsdorf:

Antimony,	-	67.50
Oxygen,	-	10.80
Sulphur,	-	19.70
		98.00

Klaproth, Beit. b. iii. s. 182.

Geognostic Situation.

This rare mineral occurs in veins, in primitive rocks, generally along with native antimony, grey antimony, and ores of arsenic, and these are associated with quartz, iron-pyrites, and calcareous-spar.

Geographic Situation.

It occurs at Braunsdorf in Saxony; Allemont in France; in Tuscany; at Malaczka in Hungary; and Felsobanya in Transylvania.

Observations.

1. The cherry-red colour, acicular, variously aggregated crystals, and lustre, are the principal characters of this mineral; it is distinguished from *Red Silver* and *Red Copper-ore* by its colour, fracture, and inferior specific gravity.

2. It has been described under the name *Natürlicher Mineral Kermes.*

Second Subspecies.

Tinder Antimony-Blende.

Zundererz, *Werner.*

Zundererz, *Reuss*, b. iii. s. 382. *Id. Leonhard*, Tabel. s. 79. *Id. Karsten*, Tabel. s. 72. *Id. Haus.* Handb. b. i. s. 226. *Id. Hoff.* b. iv. s. 117.

External Characters.

Its colour is muddy cherry-red.

It occurs in very delicate flexible tinder-like leaves, which have sometimes a promiscuous fibrous texture.

Its lustre is feebly glimmering.

It is opaque.

It becomes shining in the streak.

It is friable.

It is sectile and flexible.

It is easily frangible.

Chemical Characters.

Before the blowpipe, the antimony, lead and sulphur, evaporate, and colour the charcoal white and yellow; the residuum melts into a black magnetic slag.

Constituent Parts.

According to an analysis by Link, this ore appears to contain in 100 parts, 33 of Oxide of Antimony, 40 of Oxide of Iron, 16 of Lead, and 4 of Sulphur. It also contains a portion of Silver.—Vid. N. Journ. de Chem. v. s. 461.

Geognostic

Geognostic and Geographic Situations.

It occurs principally in the mines named Carolina and Dorothea at Clausthal, where it is associated with crystals of quartz, calcareous-spar, and lead-glance.

Use.

It is considered as an ore of silver in the districts where it occurs.

Observations.

It is named Tinder Antimony-Blende, from the leaves, which resemble in form and general aspect the substance named Tinder.

GENUS IV.—RUBY-BLENDE.

Rubin-Blende, *Mohs.* *

This genus contains two species, viz. Rhomboidal Ruby-Blende, and Prismato-rhomboidal Ruby-Blende.

1. Rhomboidal Ruby-Blende, or Red Silver.

Rhomboedrische Rubin-Blende, *Mohs.*

This species is divided into two subspecies, viz. Dark Red Silver and Light Red Silver.

* Red Zinc.

First

First Subspecies.

Dark Red Silver.

Dunkles Rothgiltigerz, *Werner*.

Id. Werner, Pabst. b. i. s. 45. *Id. Wid.* s. 703.—Dark red Silver-ore, *Kirw.* vol. ii. p. 123.—Dunkles Rothgiltigerz, *Estner*, b. iii. s. 410. *Id. Emm.* b. ii. s. 185.—L'Argent rouge foncé, *Broch.* t. ii. p. 143.—Argent antimonié sulphuré, *Haüy*, t. iii. p. 402,–416.—Dunkles Rothgiltigerz, *Reuss*, b. iii. s. 358. *Id. Lud.* b. i. s. 215. *Id. Suck.* 2ter th. s. 153. *Id. Bert.* s. 372. *Id. Mohs*, b. iii. s. 168. *Id. Leonhard*, Tabel. s. 55. —Argent rouge sombre, *Brong.* t. i. p. 254.—Dunkles Rothgiltigerz, *Karsten*, Tabel. s. 60. *Id. Haus.* s. 77.—Antimoniated Sulphuret of Silver, *Kid*, vol. ii. p. 89.—Argent antimonié sulphuré rouge obscur, *Haüy*, Tabl. p. 76.—Dunkles Rothgiltigerz, *Haus.* Handb. b. i. s. 221. *Id. Hoff.* b. iii. s. 68.—Red or ruby Silver, *Aikin*, p. 79.

External Characters.

Its colour is intermediate between cochineal-red and dark lead-grey, which sometimes passes into blackish lead-grey, and even inclines to iron-black.

It occurs massive, disseminated, in membranes; and crystallized.

Its primitive figure is a rhomboid of 109° 28′; and the following are the secondary figures:

1. Equiangular six-sided prism, which is either perfect, or truncated on the terminal edges and angles, or on the alternate lateral edges.
2. Equiangular six-sided prism, flatly acuminated with three

three planes, which are set on the alternate lateral planes. Sometimes the summit and the edges of the acumination are truncated.

3. Equiangular six-sided prism, very flatly acuminated with six planes, which are set on the lateral planes. The summits of the acuminations are sometimes so deeply truncated, that the acuminating planes become truncations on the terminal edges.
4. The preceding figure, in which the six planed acumination is again acuminated with three planes, which are set on the alternate lateral edges of the first acumination.
5. Equiangular double six-sided pyramid, flatly acuminated with six planes, which are set on the lateral planes.

The crystals are sometimes acicular and capillary, and are middle-sized, small, and very small.

The surface of the crystals is generally smooth, and rarely transversely streaked.

Externally it alternates from shining to splendent, and the lustre is semi-metallic or adamantine.

Internally it alternates from shining to glimmering, and has sometimes an adamantine, sometimes a semi-metallic lustre.

The cleavage is rhomboidal.

The fracture of the massive and other similar varieties is usually coarse and fine-grained uneven; that of the crystallised varieties imperfect and small conchoidal.

The fragments are indeterminate angular, and blunt-edged.

The massive varieties are opaque; those which are crys-
tallised

tallized semi-transparent, passing into transparent, and some times only translucent.

The streak is cochineal-red, and the lustre unchanged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is sectile, but not in so high a degree as brittle silver-glance.

It is easily frangible; more easily frangible than brittle silver-glance.

Specific gravity, 5.2, 5.7, *Mohs.* 5.608, 5.684, *Gellert.* 5.5687, *Brisson.*

Chemical Characters.

Before the blowpipe, it first decrepitates, then melts with a slight effervescence, and the disengagement of sulphureous and antimonial yellow and white vapours, leaving behind a globule of silver.

Constituent Parts.

Silver, - - -	60.0
Antimony, - -	20.3
Sulphur, - -	14.7
Oxygen, - -	5.0
	100.0

Klaproth, Beit. b. v. s. 200.

Or, according to Thenard, 58.4 Oxide of Silver; 23.5 Oxide of Antimony; and 16 of Sulphur.

Geognostic Situation.

It occurs in veins in gneiss, mica-slate, porphyry, and grey-wacke, along with brittle silver-glance, white silver, galena

galena or lead-glance, iron-pyrites, sparry iron, blende, copper-pyrites, zeolite, cross-stone, calcareous-spar, and brown-spar.

Geographic Situation.

Europe.—It was at one time met with in a cross vein in Huel Duchy mine in Cornwall, associated with native silver and black silver. On the Continent of Europe, it is met with in the silver-mines of Kongsberg, already so often mentioned; also in those of the Hartz, where it is sometimes associated with galena or lead-glance, iron-pyrites, quartz, and calcareous-spar; sometimes with galena or lead-glance, native arsenic, hepatic pyrites, quartz, and calcareous-spar: at Schemnitz, it is generally accompanied with brittle silver-glance: at Kremnitz, its accompanying minerals are brittle silver-glance, iron and copper pyrites, brown-spar, quartz, and amethyst, and sometimes silver-glance and galena or lead-glance: at Boitza in Transylvania, it occurs along with iron-pyrites, yellow blende, galena or lead-glance, brittle silver-glance, brown-spar, common quartz, and amethyst: at Joachimsthal in Bohemia, it is found imbedded in quartz, calcareous-spar, or hepatic pyrites, and is accompanied with brittle silver-glance, and several other ores.

America.—This ore forms a principal part of the wealth of Sombrerete, Cosala, and Zolaga, near Villalta, in the province of Oaxaca in Mexico. From this ore more than 700,000 marcs of silver have been extracted, in the famous mine of *La Veta Negra*, near Sombrerete, in the space of from five to six months. It is affirmed, that the mine which produced this enormous quantity of metal, the greatest

est which was ever yielded by any vein on the same point of its mass, was not ninety-eight feet in length

Observations.

Colour, form, lustre, and streak, and inferior specific gravity, distinguish it from *Brittle Silver-glance;* and its form, fracture, want of distinct concretions, and streak, distinguish it from *Dark Red Cinnabar.*

Second Subspecies.

Light Red Silver.

Lichtes Rothgiltigerz, *Werner.*

Id. Werner, Pabst. b. i. s. 52. *Id. Wid.* s. 706.—Light Red Silver-ore, *Kirw.* vol. ii. p. 122.—Lichtes Rothgiltigerz, *Estner,* b. iii. s. 426. *Id. Emm.* b. ii. s. 190.—L'Argent rouge clair, *Broch.* t. ii. p. 147.—Argent antimonié sulphuré rouge vif, *Haüy,* t. iii. p. 410.—Lichtes Rothgiltigerz, *Reuss,* b. iii. s. 365. *Id. Lud.* b. i. s. 217. *Id. Suck.* 2ter th. s. 102. *Id. Bert.* s. 375. *Id. Mohs,* b. iii. s. 193. *Id. Leonhard,* Tabel. s. 55. *Id. Karsten,* Tabel. s. 60. *Id. Haus.* s. 76.—Argent antimonié sulphuré rouge vif, *Haüy,* Tabl. p. 65.—Lichtes Rothgiltigerz, *Haus.* Handb. b. i. s. 221. *Id. Hoff.* b. iii. s. 74.

External Characters.

Its colour is cochineal-red, which passes on the one side into a colour intermediate between cochineal-red and lead-grey,

* Humboldt's New Spain, vol. iii. p. 155. Black's translation.

grey, and on the other it approaches to carmine-red. It has rarely a columbine tarnish.

It occurs massive, disseminated, in membranes, small botryoidal, and crystallised.

Its crystallizations are nearly the same with those of the preceding subspecies; but of all the forms, the most frequent is the double six-sided pyramid.

The crystals are seldom middle-sized, usually small, and very small, and occur in druses.

The surface of the crystals is usually smooth, sometimes streaked; the streaks being longitudinal in the prisms, but oblique in the pyramids, and sometimes drusy.

Externally the lustre is splendent, passing into shining.

Internally it alternates from shining to glistening, and has usually an adamantine lustre; the varieties that incline to the foregoing subspecies have a semi-metallic lustre.

The fracture is usually imperfect and small conchoidal, which sometimes passes into coarse and small-grained uneven.

The fragments are rather sharp-edged.

The massive varieties are generally translucent on the edges; the crystallised usually transparent.

The streak is aurora-red, passing into cochineal-red.

Specific gravity, 5.443, *Gellert*; 5.5886, *Brisson*; 5.592, *Vauquelin*.

Chemical Characters.

On Charcoal, before the blowpipe, it melts, blackens, and burns with a blue flame like sulphur, diffusing a white smoke, and a feeble garlic smell, and leaves a globule of nearly pure slver.—*Vauquelin*.

Constituent

Constituent Parts.

From the mine called Catharina Neufang, at Andreasberg.		Mine called Churprinz Friedrich August, near Freyberg.	1st Analysis.	2d Analysis.
Silver,	60.0	62.00	56.6748	54.2713
Antimony,	20.3	18.50	16.13	16.3
Sulphur,	14.7	14.45	15.0666	17.75
Oxygen,	5.0	5.05	12.1286	11.8487
	100.00	100.0	100	100
	Klaproth.	*Klaproth.*	*Vauquelin.*	*Vauquelin.*

Oxide of Silver, -	58.4
Oxide of Antimony,	23.5
Sulphur, - -	16.0
	97.9
	Thenard.

From Johanngeorgenstadt.	
Silver, -	61.0
Antimony, -	19.0
Sulphur, -	11.1
Sulphuric Acid,	7.0
Arsenic, -	2.9
	101
	Lampadius.

Geognostic Situation.

It occurs in veins, in the same species of rocks as the dark red subspecies, but is distinguished from it by its accompanying minerals, which are, native arsenic, red orpiment, nickel-pyrites, white cobalt, straight lamellar heavy-spar, calcareous-spar, and fluor-spar, and occasionally native silver, silver-glance, copper-pyrites, and small quantities of galena or lead-glance, iron-pyrites, and sparry iron.

Geographic Situation.

Europe.—This mineral occurs at Andreasberg in the Hartz, where it is accompanied with native arsenic, quartz, and calcareous-spar; in many of the mines in the kingdom

dom of Saxony, as at Kurprinz Friedrich-August at Gross-scherma, along with native arsenic, and lamellar heavy-spar; at Himelsfürt, along with native arsenic, copper-pyrites, heavy-spar, brown-spar, and quartz; at Johanngeorgenstadt, with white cobalt, nickel-ochre, silver-glance, and iron-pyrites; at Marienberg, with white cobalt, naitve arsenic, galena or lead-glance, dark-red silver, iron-pyrites, heavy-spar, calcareous-spar, fluor-spar, sparry-iron, and brown-spar; at Schneeberg, with white cobalt, dark-red silver, copper-nickel, or nickel-pyrites, iron-pyrites, sparry iron, calcareous-spar, and quartz; at Joachimsthal in Bohemia, it is accompanied with common silver-glance, brittle silver-glance, white cobalt, orpiment, copper-pyrites, sparry iron, brown-spar, calcareous-spar, heavy-spar, and hornstone; at Markirchen in Alsace, along with native arsenic, silver-glance, galena or lead-glance, copper-pyrites, brown-spar, calcareous-spar, and quartz; in the Sierra Morena in Spain, along with arsenical silver, and calcareous-spar; and at Schemnitz and Kremnitz in Hungary.

America.—It is found in the mines of Guanaxuato, in some veins, associated with native gold, common silver-glance, brittle silver-glance, copper green, blue copper, iron-pyrites, quartz, and calcareous-spar; in others with native gold, galena or lead-glance, zinc-blende, copper-pyrites, iron-pyrites, and sparry iron. In the mining district of Porco, in Potosi in Peru, it is accompanied with dark-red silver, native silver, blende, iron-pyrites, and calcareous-spar.

Uses.

Both subspecies are smelted, on account of the silver they contain. The dark-red is considerably more productive than the light red.

Observations.

Observations.

1. Red Silver, Cinnabar, and Red Copper-ore, have several characters in common: the following, however, sufficiently distinguish them from one another.

Cinnabar has a specific gravity of 7.0, and is almost always accompanied with native mercury and iron-ochre; whereas the specific gravity of Red Silver does not exceed 5.7; and its accompanying fossils, as already mentioned, are very different from those of cinnabar.

Red Copper-ore has a specific gravity of 5.6, 6.0, and is usually accompanied with native copper, malachite, and brown iron-ochre,—characters that distinguish it sufficiently from Red Silver.

2. Red Silver has a slight resemblance to *Copper-glance* and *Red Orpiment.* Copper-glance gives a blackish streak; red orpiment an orange-yellow streak, and its specific gravity is only 3.2,—characters that distinguish them at once from Red Silver.

3. The colour of the streak distinguishes the two subspecies from one another: the dark-red affords a cochineal or brick-red coloured streak; but the light-red an aurora-coloured streak.

4. The Light Red Silver, as already mentioned, occurs usually with native arsenic, and white cobalt, also with orpiment and heavy-spar; but the dark, on the contrary, with galena or lead-glance, white silver, brittle silver, quartz, calcareous-spar, and iron-pyrites. They are thus, by these geognostic characters, well distinguished from one another.

5. In the Hartz and Hungary, dark red silver occurs frequently, the light red rarely.

2. Prismato-rhomboidal Ruby-Blende or Cinnabar.

Prismato-Rhomboedrische Rubin-Blende, *Mohs.*

This species is divided into three subspecies, viz. Dark Red Cinnabar, Bright Red Cinnabar, and Hepatic Cinnabar.

First Subspecies.

Dark Red Cinnabar.

Dunkel-rother Zinnober, *Werner.*

Minium, *Plin.* Hist. Nat. xxxiii. s. 38. (ed. Bip. 5. v. 204.)—Dunkel-rother Zinnober, *Werner,* Pabst. b. i. s. 8. *Id. Wid.* s. 728.—Dark Red Cinnabar, *Kirw.* vol. iii. p. 228.—Dunkel-rother Zinnober, *Estner,* b. iii. s. 290. *Id. Emm.* b. ii. s. 144.—Le Cinnabre d'un rouge foncé, ou le Cinnabre commun, *Broch.* t. ii. p. 107.—Mercure sulphuré, *Haüy,* t. iii. p. 437.—Dunkel-rother Zinnober, *Reuss,* b. iii. s. 287. *Id. Lud.* b. i. s. 207. *Id. Suck.* 2ter th. s. 118. *Id. Bert.* s. 436. *Id. Mohs,* b. iii. s. 76. *Id. Leonhard,* Tabel. s. 52.—Mercure sulphuré compacte, *Brong.* t. ii. p. 243.—Gemeiner Zinnober, *Karsten,* Tabel. s. 60.—Blättriger Zinnober, & Dichter Zinnober, *Haus.* s. 76.—Sulphuret of Quicksilver, *Kid,* vol. ii. p. 94.—Mercure sulphuré couleur rouge foncé, *Haüy,* Tabl. p. 78.—Dunkel-rother Zinnober, *Haus.* Handb. b. i. s. 214. *Id. Hoff.* b. iii. s. 27.—Cinnabar, *Aikin,* p. 82.

External Characters.

Its principal colour is perfect cochineal-red, which in some varieties inclines very much to lead-grey; in others passes into carmine-red.

Besides

Besides massive, disseminated, in blunt-cornered pieces, in flakes, dendritic, and in granular distinct concretions: it also occurs crystallized. Its primitive form appears to be a rhomboid, the dimensions of which are still unknown. The following are some of the secondary forms:

1. Regular six-sided prism, sometimes flatly acuminated with three planes, which are set on the alternate lateral planes.
2. Rather acute rhomboid, truncated on the apices. When these truncating planes become so large as to assume the size of lateral planes, a figure is formed, having an octahedral form. When the truncating planes become still larger, there is formed a
3. Six-sided table, in which the terminal planes are set on obliquely.

The crystals are small and very small; occur in druses, on one another, side by side, and promiscuous.

Externally the crystals are splendent.

Internally it alternates from shining to glimmering, and the lustre is adamantine, verging on semi-metallic.

The cleavage is in the direction of the sides of the six-sided prism.

The fracture is sometimes fine-grained uneven, sometimes even and conchoidal.

The fragments are indeterminate angular, and blunt-edged.

The massive varieties are opaque, or translucent on the edges; the crystals are translucent, sometimes semi-transparent, and even verging on transparent.

It yields a scarlet-red shining streak.

It is harder than gypsum, but not so hard as calcareous-spar.

It is sectile, and easily frangible.

Specific gravity, 6.7, 8.2, *Mohs*; Japan Cinnabar, 7.710, *Klaproth*; Almaden Cinnabar, 7.786, *Kirwan*.

Chemical Characters.

Before the blowpipe, it melts, and is volatilised with a blue flame, and sulphureous odour.

Constituent Parts.

	Japan.*	Neumarktel in Carniola.
Mercury,	84.50	85.00
Sulphur,	14.75	14.25
	99.25	99.25

Klaproth, Beit. b. iv. s. 17. & 19.

For Geognostic and Geographic Situations, see the following subspecies.

Second Subspecies.

Bright Red Cinnabar

Hochrother Zinnober.

Id. Wern. Pabst. b. i. s. 11. *Id. Wid.* s. 727. *Id. Estner*, b. iii. s. 297. *Id. Emm.* b. ii. s. 146.—Le Cinnabre d'un rouge vif, ou le Cinnabre fibreux, *Broch.* t. ii. p. 111.—Mercure sulphuré rouge vif, *Haüy*, t. iii. p. 440.—Lichtrother Zinnober, *Reuss*, b. iii. s. 293.—Hochrother Zinnober, *Lud.* b. i. s. 208. *Id. Mohs*, b. iii. s. 86. *Id. Leonhard*, Tabel. s. 52.—Mercure sulphuré fibreux, *Brong.* t. ii. p. 243.—Zerreblicher Zinnober,

* It is also named *Native Vermilion*.

Zinnober, *Karsten,* Tabel. s. 60.—Erdiger Zinnober, *Haus.* s. 76.—Mercure sulphuré couleur rouge vif, *Haüy,* Tabl. p. 78.—Lichtrother Zinnober, *Haus.* Handb. b. i. s. 215. —Hochrother Zinnober, *Hoff.* b. iii. s. 31.

External Characters.

Its colour is bright scarlet-red, which sometimes inclines to carmine-red.

It occurs massive, disseminated, in flakes, and sometimes in very delicate fibrous concretions.

Internally it is glimmering and pearly.

The fracture is earthy.

The fragments are indeterminate angular, and blunt-edged.

It is opaque.

The streak is shining.

It soils.

It is very soft, passing into friable.

It is imperfectly sectile, and very easily frangible.

Geognostic Situation.

This mineral occurs in small quantities in beds and veins, in rocks of clay-slate, talc-slate, and chlorite-slate, and is associated with quartz, calcareous-spar, sparry iron, and with minuter portions of iron-pyrites, copper-pyrites, iron-glance or specular iron-ore, and micaceous iron-ore; also in veins that traverse trap-porphyry, pitchstone and hornstone porphyries, and alpine limestone, but most abundantly along with sandstone, slate-clay, &c. in the coal formation.

Geographic

Geographic Situation.

Europe.—It occurs in veins at Horzowitz in Bohemia, where it is associated with red iron-ore, sparry iron, galena or lead-glance, yellow blende, and straight lamellar heavy-spar; at Idria in the Friaul, in a coal formation; at Rosenau in Upper Hungary, in clay-slate, chlorite-slate, and talc-slate; in veins, along with ironstone, and ores of mercury, at Schemnitz and Kremnitz in Lower Hungary; Transylvania; Carinthia; Carniola; Salzburg; Tuscany; Sicily; in a coal formation at Wolfstein and Morsfeld in the Palatinate; at Moschellandsberg and Stahlberg in Deux Ponts; Allemont and Pellançon in France; at Almaden in Spain, in a coal formation; and in the neighbourhood of Conna in Portugal.

Asia.—Nertschinsk and Terentui in Siberia; also in the peninsula of Taygonos, near the mouth of the river Topolefka in Kamtschatka; and in Japan.

America.—Mines of cinnabar occur in different parts of New Spain. At Durasno, between Terra Neuva and San Luis de la Paz, cinnabar, mixed with globules of mercury, forms a horizontal bed, which rests on porphyry. This bed is covered with strata of slate-clay, impregnated with nitrate of potash, which include a bed of slate-coal, and contain fragments of petrified vegetables. The cinnabar vein of San Juan de la Chica, is six, nine, and even sometimes twenty feet in width. It occurs in pitchstone-porphyry, which is disposed in globular and concentric lamellar concretions, of which the centre is occupied with hyalite. The cinnabar, and a little native mercury, are sometimes observed in the middle of the porphyritic rock, at a very considerable distance from the vein. The cinnabar extracted from the veins of the mountain

del Fraile, near the Villa de San Felipe, is found in porphyry with a hornstone base, which is traversed by veins of tinstone.

In the kingdom of new Granada, cinnabar occurs in three different places, namely, in the province of Antioquia, in the Valle de Santa Rosa, east from the Rio Cauca; in the mountain of Quindiu, in the pass of the central Cordillera, between Ibaque and Carthago, at the extremity of the ravine of Vermellon; and lastly, in the province of Quito, between the village of Azogue and Cuenca. The cinnabar is not only found in round fragments, mixed with small grains of gold, in the alluvial soil with which the ravine de Vermellon, at the foot of the table-land of Ibague Viejo, is filled: but they know the vein also from which the torrent appears to have detached these fragments, and which traverses the small ravine of Santa Anna. Near the village of Azogue, to the N.W. of Cuenca, the mercury is found, as in the department Mont Tonnerre, in a formation of quartzy sandstone, with a clay base or cement. This sandstone is nearly 4592 feet in thickness, and contains bituminous wood and mineral pitch.

In Peru, cinnabar is found near Valdivui, in the province of Pataz, between the eastern bank of the Maranon and the missions of Guailillas; at the foot of the great Nevado de Pelagato, in the province of Conchucos, to the east of Santa; near Huancavelica, in the intendancy of that name; near Guaraz, in the province of Guailas; and at the Baths of Jesus, in the province of Guamalies; to the south-east of Guacarachuco. The famous mine of Huancavelica, as to the state of which so many false ideas have been disseminated, is in the mountain of Santa Barbara, to the south of the town of Huancavelica, at a horizontal

zontal distance of 7606 feet. The height of the town above the level of the sea is 12,308 feet. If we add to this the height of the mountain Santa Barbara above the level of Huancavelica, we shall find the absolute height of this mountain to be 14,506 feet. The cinnabar is found in the vicinity of this town, in two very different repositories, in beds, and in veins. In the great mine of Santa Barbara, the cinnabar is contained in a bed of sandstone, of upwards of 1200 feet in thickness. This sandstone is analogous to that of the environs of Paris; and the mountains of Aroma and Cascas, in Peru, resemble pure quartz. The quartz rock which contains the cinnabar, forms a bed in a limestone conglomerate, from which it is only separated by thin layers of slate-clay. This conglomerate is covered with a flœtz limestone, and the fragments of compact limestone in the conglomerate seem to indicate, that the whole mass of the mountain of Santa Barbara itself reposes on what is called Alpine Limestone. The cinnabar does not fill the whole quartz bed of the great mine of Santa Barbara: it forms particular layers, and sometimes it is found in small veins, that occasionally unite into *stock-werke*. Hence, the metalliferous mass is only in general from 196 to 229 feet in breadth. Native mercury is very rare; but the cinnabar is accompanied with red iron-ore, magnetic iron-ore, galena, and iron-pyrites, and also with calcareous-spar, sulphate of lime, and fibrous alum. The metalliferous bed, at great depths, contains a good deal of orpiment. Cinnabar is also found near to Sillacasa, in small veins which traverse the alpine limestone; but these veins, which are frequently full of calcedony, do not follow regular directions: they cross each other, and form nests, often of considerable magnitude. It is these veins that at present furnish

furnish all the mercury of Peru, the metalliferous bed of the great mine of Santa Barbara having been completely abandoned, owing to the works having fallen in.*

The most important mercury mines at present in a state of activity are those near Almaden in Spain, which have been worked for upwards of 2000 years; at Idria in the Friaul; in the ci-devant Palatinate; Deux Ponts; and in Spanish America.

Uses.

It is the mineral from which the greatest quantity of the mercury of commerce is obtained. It is also used by the painter as a pigment; but artificial cinnabar, on account of the purity and brightness of its colour, is preferred. It is also used for tinting wax of a red colour.

Observations.

1. It is distinguished from *Red Silver*, by its scarlet-red streak, and the red trace it affords on paper; and also in being entirely volatilised when heated: From *Red Orpiment*, by the colour of its streak, that of red-orpiment being orange-yellow; and from *Red Lead-Spar*, also by the streak, that of the lead-ore being lemon-yellow.

2. It appears from Vitruvius, that the term *Minium* was derived from the name of a river in Spain; and there are several passages in Pliny, which shew that the term minium was applied to a substance corresponding with our cinnabar. He says, that almost all the minium in use

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* Vide Black's Translation of Humboldt's New Spain, from which the above particulars in regard to the Spanish American mercury mines have been obtained.

use at Rome, came from Spain, and that the ore was sent over from Spain sealed. He also says, that those who were employed in reducing minium to powder, wore loose bladders over the face, lest they should inhale the dust; the effects of which were very pernicious. This custom is also observed at the present day, by those who are employed for a length of time in triturating preparations of mercury *.

3. The term *Cinnabar*, was originally applied to the drug commonly called *Dragon's Blood*, which is of a dull red colour: it was afterwards transferred to the ore of mercury now under consideration †.

4. Sage, in the Journal de Physique for 1784, and Estner, in his Mineralogie, B. iii. 2. s. 314. describe a native red oxide of mercury found at Idria; but it has not been met with by succeeding naturalists.

5. Baron Born, in his *Catalogue rais. d. l. Collect. d. Mlle, de Raab.* t. ii. p. 394. describes a mineral under the name *Cinnabre alcalin*, which is mentioned by Wideman, Estner, Reuss, and Hausmann, under the name *Stink Zinnober*. The following description is given of it:

Its colour is intermediate between crimson-red and blood-red. It occurs massive, disseminated, in vesicles, and indistinctly crystallised. Internally the lustre is shining and adamantine. The fracture is imperfect foliated, inclining to radiated. It is translucent. It is soft. When triturated, it emits a hepatic smell. It is said to be sulphuret of mercury, combined with sulphureted hydrogen. It is found at Idria, along with calcareous-spar, and iron-pyrites.

Third

* Kid's Min. vol. ii. p. 95. † Ibid.

Third Subspecies.

Hepatic Cinnabar.

Quecksilber Lebererz, *Werner.*

This subspecies contains two kinds, viz. Compact Hepatic Cinnabar, and Slaty Hepatic Cinnabar.

First Kind.

Compact Hepatic Cinnabar.

Dichtes Quecksilber Lebererz, *Werner.*

Id. Werner, Pabst. b. i. s. 8.—Compact Hepatic Mercurial-ore, *Kirw.* vol. ii. p. 224.—Dichtes Quecksilber Lebererz, *Estner,* b. iii. s. 281. *Id. Emm.* b. ii. s. 140.—Mine de Mercure hepatique, *Broch.* t. ii. p. 104.—Dichtes Lebererz, *Reuss,* b. iii. s. 282. *Id. Lud.* b. i. s. 207. *Id. Mohs,* b. iii. s. 88.—Mercure sulphuré hepatique, *Brong.* t. ii. p. 243.—Dichtes Lebererz, *Karsten,* Tabel. s. 60. *Id. Haus.* s. 76.—Mecure sulphuré bituminifère compacte, *Haüy,* Tabl. p. 78.—Dichtes Lebererz, *Haus.* Handb. b. i. s. 216.—Dichtes Quecksilber Lebererz, *Hoff.* b. iii. s. 33.—Hepatic Cinnabar, *Aikin,* p. 83.

External Characters.

Its colour is intermediate between dark cochineal-red and dark lead-grey.

It occurs massive.

Internally it is glimmering, and the lustre is semi-metallic.

The fracture is even, and sometimes passes into fine or small-grained uneven.

The

The fragments are indeterminate angular, and rather sharp-edged.

The streak is shining, and of a cochineal-red colour, inclining to lead-grey.

It is opaque.

It is soft.

It is sectile and easily frangible.

Specific gravity, 7.186 to 7.352, *Kirwan*; 7.100 *Klaproth.*

Constituent Parts.

Mercury, - - -	81.80
Sulphur, - - -	13.75
Carbon, - - -	2.30
Silica, - - - -	0.65
Alumina, - - -	0.55
Oxide of Iron, - - -	0.20
Copper, - - -	0.02
Water, - - -	0.73
	100

Klaproth, Beit. b. iv. s. 24.

Second Kind.

Slaty Mercurial Hepatic-Ore.

Schiefriges Quecksilber Lebererz, *Werner.*

Schiefriges Lebererz, *Reuss,* b. iii. s. 284. *Id. Lud.* b. i. s. 207. *Id. Mohs,* b. iii. s. 89. *Id. Karsten,* Tabel. s. 60. *Id. Haus.* s. 76.—Mercure sulphuré bitumine testacé, *Haüy,* Tabl. p. 78. —Körniges

—Körniges und Schaaliges Lebererz, *Haus.* Handb. b. i. s. 217.—Schiefriges Quecksilber Lebererz, *Hoff.* b. iii. s. 36.

External Characters.

Its colour is nearly the same with the preceding kind, but sometimes so dark that it inclines to black.

It occurs massive and disseminated: seldom in roundish imbedded portions, and also in globular and concentric lamellar concretions.

The lustre of the principal fracture is shining, approaching to splendent; that of the cross fracture is glimmering, and both have a semi-metallic lustre.

The principal fracture is curved and thick slaty; the coarse fracture is even.

The fragments are slaty.

It is uncommonly easily frangible.

The streak is cochineal-red, inclining to brown.

It is rather lighter than the compact kind.

Geognostic Situation.

This mineral occurs in considerable masses in slate-clay and bituminous-shale. It is sometimes intermixed with cinnabar and iron-pyrites; and veins of native mercury and of cinnabar occasionally traverse it. Both kinds occur together.

Geographic Situation.

It occurs most abundantly in Idria: it is also met with at Almaden in Spain, Nertschinsk in Siberia, and in Deux Ponts.

Observations.

Observations.

1. This kind is characterised by its higher degree of lustre, slaty fracture, easier frangibility, and rather lower specific gravity.

2. The variety in globular and concentric lamellar concretions is named *Corallenerz*.

3. When exposed for some time to the air, it acquires a silver-brown tint of colour: hence the name *Hepatic* or *Liver-Ore* given to it.

4. It appears to contain more carbon than the compact kind. The two kinds appear to bear the same relation to each other that common alum-slate does to glossy alum-slate.

* Red Zinc, or Red Oxide of Zinc †.

Red Oxide of Zinc, *Bruce*.

Red Zinc-ore, *Bruce's* American Mineralogical Journal, p. 96. —*Cleaveland's* Min. p. 352.

External Characters.

Its colours are blood-red and aurora-red.

It occurs massive, disseminated.

Internally, on the fresh fracture it is shining; after long exposure to the air it becomes dull, and even covered with a pearly crust.

It has a single cleavage.

The fracture is conchoidal.

It

† This mineral is placed here, from its general resemblance in external aspect to the species of this genus. Farther examination will determine if the present is its proper place in the system.

It is translucent on the edges, or opaque.

It is easily scratched by the knife.

It is brittle.

It affords a streak which is brownish-yellow, approaching to orange.

Specific gravity 6.220.

Chemical Characters.

It is soluble in the mineral acids. It is infusible without addition before the blowpipe. With sub-borate of soda, melts with a transparent yellow bead. When exposed to the united flames of oxygen and hydrogen, it sublimes, attended with a brilliant white light. When pounded, mixed with potash, and exposed to heat, it fuses into an emerald-green mass, which, on solution, affords to water the same colour. On the addition of a few drops of nitric, sulphuric, or muriatic acids, the green-coloured fluid is immediately changed into a rose-red.

Constituent Parts.

Zinc, - -	76
Oxygen, - -	16
Oxides of Manganese and Iron,	8
	100

Bruce, American Min. Journ. p. 99.

Geognostic and Geographic Situation.

This mineral has been hitherto found only in North America, where it occurs in several of the iron-mines in Sussex County, New Jersey; as at the Franklin, Stirling, and Rutgers mines, and near Sparta. In some instances it

it is imbedded in foliated granular limestone; while in others, it serves as a basis in which magnetic ironstone occurs, either in crystals or grains.

At Franklin, it also assumes a micaceous form, and is imbedded in a whitish oxide of zinc*, which is often, in the same specimen, found adhering to the black oxide of iron.

Uses.

This species occurs abundantly in the United States of America, and promises to be a valuable acquisition to that country. Dr Bruce, to whom we are indebted for every thing we know of this mineral, remarks: "The recently discovered property of the malleability of zinc, at a temperature of 300° of Fahrenheit, has greatly enhanced its value, and raised it to a high rank among the useful metals. The inconvenience arising from its brittleness being removed, this metal is now applied to many of the purposes for which copper has been hitherto used. As the demand for metallic zinc must necessarily increase as its application to the arts becomes more general, the red zinc-ore will prove a source from which this metal may be procured in abundance; and a series of experiments sufficiently shews the ease with which it may be separated from the ore. In the manufacture of brass, this ore possesses advantages over those generally used; as, without previous preparation of ustulation, &c. it affords with copper a compound possessing a high degree of malleability, a fine colour, and every requisite of the best kind of brass, such as is used in the finest and most delicate workmanship, equal in every respect to that made from the reduced metal, or, as it is more generally termed, *spelter*. This mineral may also be advantageously employed

ployed in the manufacture of sulphate of zinc, or white vitriol of commerce. Experiments also prove, that the oxide or flowers of zinc may, without much difficulty, be obtained from this ore. The oxide of zinc has of late been recommended as a substitute for white-lead as a pigment, over which it possesses some advantages, as it is not liable to change, and in its preparation is not subject to those deleterious consequences so frequently attendant on all the preparations of lead."

Observations.

1. It is distinguished from *Red Silver*, by its infusibility before the blowpipe: from *Red Copper-ore*, by its superior specific gravity, and its solution in acids, which is colourless, whereas that of the red copper-ore is of a bright green: from *Red Lead-spar*, by its infusibility before the blowpipe, the red lead-spar melting into a blackish slag: *Red Orpiment*, with which it might be confounded, is distinguished from it by its volatility before the blowpipe, and giving out a blue flame, and a strong garlic smell; and its solubility in the mineral acids distinguishes it from *Rutile*, which is insoluble.

2. This interesting mineral was first discovered by Dr Bruce, and by him described in the American Mineralogical Journal.

3. The red colour of this ore is conjectured to be owing to the oxide of iron and manganese it contains.

CLASS IV.

ORDER VI. SULPHUR.

GENUS I. SULPHUR.

Schwefel, *Mohs.*

This genus contains three species, viz. Red Orpiment, Yellow Orpiment, and Prismatic Sulphur.

1. Red Orpiment, or Ruby Sulphur, or Hemi-Prismatic Sulphur.

Hemi-prismatisches Schwefel, *Mohs.*

Rothes Rauschgelb, *Werner.*

Sandaraca, *Plin.*—Arsenicum risigallum, *Wall.* t. ii. p. 163.—Realgar, et Soufre rouge des Volcans, *Romé de Lisle,* t. iii. p. 33.—Rothes Rauschgelb, *Werner,* Pabst. b. i. s. 210. *Id. Wid.* s. 975.—Realgar, *Kirw.* vol. ii. p. 261.—Realgar, Sandarac, Rubine d'Arsenic, *De Born,* t. ii. p. 199.—Rothes Rauschgelb, *Emm.* b. ii. s. 562.—Arsenic sulphuré, *Lam.* t. i. p. 358.—Arsenic sulphuré rouge, *Haüy,* t. iv. p. 228.—Le Realgar rouge, *Broch.* t. ii. p. 447.—Rothes Rauschgelb, *Reuss,* b. iv. s. 516. *Id. Lud.* b. iv. s. 301.—Rother Schwefel-arsenic, *Suck.* 2ter th. s. 425.—Roth Rauschgelb, *Bert.* s. 505. *Id. Mohs,* b. ii. s. 287.—Arsenic sulphuré rouge, *Lucas,* p. 163.—Rothes Rauschgelb, *Leonhard,* Tabel, s. 78.—Arsenic sulphuré realgar, *Brong.* t. ii. p. 88.—Arsenic sulphuré rouge, *Brard,* p. 362.—Dichtes Rauschgelb, *Karsten,* Tabel. s. 74.—Arsenic sulphuré rouge, *Haüy,* Tabl. p. 109.—Native Realgar, *Kid,* vol. ii. p. 205.—Realgar, *Haus.* Handb. b. i. s. 210.—Rothes Rauschgelb, *Hoff.* b. iv. s. 224.—Realgar, *Aikin,* p. 126.

External Characters.

Its colour is aurora-red, of various degrees of intensity; when the surface is weathered, the colour inclines to orange-yellow.

It occurs massive, disseminated, in flakes or membranes, and crystallised.

Its primitive figure is an oblique four-sided prism, in which the obtuse angle is 107° 42′. The following are some of the secondary figures:

1. Oblique four-sided prism, flatly acuminated on the extremities with four planes, which are set on the lateral planes *, Pl. 12. fig. 239.
2. The preceding figure, truncated on the acute lateral edges †.
3. No. 1. truncated on all the lateral edges ‡, Pl. 12. fig. 240.
4. No. 1. truncated on the obtuse lateral edges, and bevelled on the acute lateral edges §, Pl. 12. fig. 241.
5. The preceding figure, in which the edges formed by the meeting of the bevelling planes are truncated ||, Pl. 12. fig. 242.
6. Oblique four-sided prism, acuminated with four planes, which are set on the lateral planes, and all the angles formed by the meeting of the acuminating and lateral planes, truncated ¶.

The

* Arsenic sulphuré rouge emoussé, Haüy.

† Arsenic sulphuré rouge sexoctonal, Haüy.

‡ Arsenic sulphuré rouge dioctaedre, Haüy.

§ Arsenic sulphuré rouge octodecimal, Haüy.

|| Arsenic sulphuré rouge octoduodecimal, Haüy.

¶ Arsenic sulphuré rouge surcomposé, Haüy.

The crystals are seldom middle-sized, usually small, very small and minute.

The crystals are smooth, and frequently longitudinally streaked, and shining, passing into splendent.

Internally it is shining, and the lustre is resinous, inclining to adamantine.

A cleavage is discernible in the direction of both diagonals of the primitive prism.

The fracture is coarse and small-grained uneven, sometimes passing into imperfect conchoidal.

The fragments are indeterminate angular, and blunt-edged.

It is translucent but the crystals are semi-transparent.

It yields an orange-yellow coloured streak.

It is as hard as talc, but scarcely so hard as gypsum.

It is brittle, and easily frangible.

Specific gravity, 3.3, 3.4, *Mohs.* 3.3384, *Brisson.*

Chemical Characters.

It melts immediately before the blowpipe, and burns with a blue flame, giving out arsenical and sulphureous vapours. It generally leaves a minute and earthy residue.

Physical Character.

It is idio-electric by friction, acquiring the resinous or negative electricity.

Constituent Parts.

	Bannat.
Arsenic, - -	69
Sulphur, - -	31
	100

Klaproth, Beit. b. v. s. 238.

Geognostic Situation.

It occurs most frequently in veins in primitive rocks, especially in gneiss and clay-slate; also disseminated through primitive rocks, as in dolomite, where it is associated with iron-pyrites. It is rarely found in secondary rocks, when it is accompanied with yellow orpiment. It is occasionally of volcanic origin, occurring in the craters and fissures of volcanoes.

In veins it is usually accompanied with native arsenic, light red silver, galena or lead-glance; sometimes also with silver-white cobalt, iron-pyrites, grey copper, brown blende, grey and red antimony, quartz, heavy-spar, and seldom cross-stone, zeolite, and mineral pitch.

Geographic Situation.

Europe.—It occurs in veins at Andreasberg in the Hartz; disseminated in dolomite on St Gothard; in beautiful crystals at Joachimsthal in Bohemia, at Kapnic in Transylvania, and at Nagyag and Felsobanya in Hungary; and associated with volcanic substances at Vesuvius, Solfatara, and Puzzola.

Asia.—In the island of Japan *, in the mines of Kianfiu, five days journey from Nankin; and in the Burmah Dominions †.

West Indies.—It occurs in considerable quantity in the island of Guadaloupe.

America.—On the north-west coast of America, mixed with yellow orpiment.

Uses.

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* Thunberg's Travels, vol. iii. p. 203.

† Ainslie's Materia Medica, p. 53.

Uses.

It is used as a pigment. The Chinese cut it into vases and figures of different shapes, and also into vessels for medical purposes. In these vessels some vegetable acid is permitted to remain for a certain time, and is then used as a remedy in disease *.

Observations.

1. It is distinguished from *Red Silver* by its inferior specific gravity, and its orange-coloured streak; from *Red Lead-spar* by its colour, form, inferior specific gravity, and accompanying minerals; from *Cinnabar*, by the colour of its streak, that of cinnabar being scarlet-red. The strong smell of garlic, and the white fumes which it emits before the blowpipe, are characters which readily distinguish it from those minerals with which it might be confounded.

2. It has been described under the following names, Sandarach, Ruby Arsenic, Ruby Sulphur, Risigallum and Realgar.

2. Yellow Orpiment, or Prismatoidal Sulphur.

Prismatoidescher Schwefel, *Mohs.*

Gelbes Rauschgelb, *Werner.*

Αῤῥενικον of *Theophrastus;* by the latter Greeks written Αρσενικόν —Arsenicum, *Plin.* Hist. Nat. xxxiv. 18. s. 56. (ed. Bip. v. 269.)—Arsenicum auripigmentum, *Wall.* t. ii. p. 163.—Orpiment,

* Cleaveland's Mineralogy, p. 554.

piment, Orpin, *Romé de Lisle,* t. iii. p. 39.—Gelbes Rauschgelb, *Werner,* Pabst. b. i. s. 210. *Id. Wid.* s. 972.—Orpiment, *Kirw.* vol. ii. p. 260.—Oxide d'Arsenic sulphuré jaune, *De Born,* t. ii. p. 202.—Gelbes Rauschgelb, *Emm.* b. ii. s. 559. —Arsenic sulphuré jaune, *Haüy,* t. iv. p. 234.—Le Realgar jaune, *Broch.* t. ii. p. 444.—Gelbes Rauschgelb, *Reuss,* b. iv. s. 512. *Id. Lud.* b. i. s. 300.—Gelber Schwefelarsenic, *Suck.* 2ter th. s. 450.—Gelb-rauschgelb, *Bert.* s. 504. *Id. Mohs,* b. ii. s. 283.—Arsenic sulphuré jaune, *Lucas,* p. 164.—Gelbes Rauschgelb, *Leonhard,* Tabel. s. 78.—Arsenic sulphuré, Orpiment, *Brong.* t. ii. p. 89.—Arsenic sulphuré jaune, *Brard,* p. 363.—Blättriges Rauschgelb, *Karsten,* Tabel. s. 74.—Arsenic sulphuré jaune, *Haüy,* Tabl. p. 109.—Native Orpiment, *Kid,* vol. ii. p. 206.—Rauschgelb, *Haus.* Handb. b. i. s. 208.—Gelbes Rauschgelb, *Hoff.* b. iv. s. [illegible]. —Orpiment, *Aikin,* p. 127.

External Characters.

Its colour is perfect lemon-yellow, which sometimes inclines to orange-yellow.

It occurs massive, disseminated, stalactitic, reniform, botryoidal, in crusts, in granular and concentric curved lamellar concretions, and crystallised.

Its primitive form appears to be an oblique four-sided prism, the dimensions of which are unknown. The following are the secondary figures:

1. Low oblique four-sided prism, acutely bevelled on the extremities, the bevelling planes set obliquely on the obtuse edges.
2. Flat double four-sided pyramid, in which the lateral planes of the one are set on the lateral planes of the other.

On the fresh fracture it is splendent, and the lustre is intermediate between adamantine and semimetallic.

Its

Its cleavage is prismatoidal.

The fragments are indeterminate angular, and blunt-edged in the great, but slaty in the small.

It is translucent; but in small leaves transparent.

Its colour is not altered in the streak.

It is rather harder than red orpiment.

It is sectile.

It is flexible; but not elastic.

It splits easily.

Specific gravity, 3.4, 3.6, *Mohs*; 3.435, *Kirwan*; 3.400, *Breithaupt*.

Constituent Parts.

	Turkey.
Arsenic, - -	62
Sulphur, - -	38
	100

Klaproth, Beit. b. v. s. 238.

Geognostic Situation.

It occurs very rarely in primitive mountains, principally in veins in flœtz rocks, along with copper-pyrites, iron-pyrites, quartz, and calcareous-spar.

Geographic Situation.

Europe.—It occurs, along with red silver, in granite, at Wittichen in Swabia: in the Hartz; at Moldawa and Saska in the Bannat; Nagyag, and Felsobanya in Transylvania; Neusohl in Hungary; Wallachia; and Servia.

Asia.—In Natolia and China.

America.—Zimapan in Mexico; and the north-west territory of the United States.

Observations.

Observations.

1. This mineral is distinguished from *Red Orpiment*, by colour, form, cleavage, and specific gravity: from *Yellow Lead-spar*, by lustre, sectility, softness, and inferior specific gravity; from *Yellow Zinc Blende*, by colour, fracture, softness, and inferior specific gravity; from *Sulphur*, by colour and fracture; and from *Mica*, by form, want of elasticity, colour, and greater specific gravity.

2. Hausmann describes a mineral under the name *Slaggy Orpiment*, which he says has a conchoidal fracture, glistening and resinous lustre. It is found at Andreasberg in the Hartz, associated with native arsenic, red silver, and lead-glance.

3. Yellow Orpiment differs from the substance commonly called Arsenic at the present day, in containing a portion of sulphur; and in being consequently of a yellow colour; whereas our arsenic is perfectly white.

Pliny and Theophrastus describe arsenic as having a yellow colour. Thus Pliny says, that the best arsenic is "coloris in auro excellentis." Theophrastus says, on account of its resemblance in colour, *ochra* (ὤχρα) is used instead of arsenic; but the term ὤχρα itself is apparently derived from its yellow colour; and that it was of this colour, appears further probable, from its being changed to a red by calcination, which is mentioned by Theophrastus; and being thus converted into the substance called μιλτος, which answers exactly to our red ochre. Of *Sandaraca*, which is used as a synonym for realgar or red orpiment, Pliny says, "melior quo magnis rufescit." The term Αρσενικὸν, from which our word Arsenic is derived,

was

was an epithet applied by the ancients to those natural substances, the properties of which were found to be of a strong, and, as it were, *masculine* character; and as the poisonous quality of arsenic was soon found to be remarkably powerful, the term was especially applied to that form of it which was most commonly met with. The arsenic of commerce of the present day is in some instances of a yellow colour, owing to its containing a portion of sulphur.—*Kid,* Min. v. ii. p. 206, 207.

3. Prismatic Sulphur.

Prismatischer Schwefel, *Mohs.*

Natürlicher Schwefel, *Werner.*

This species is divided into two subspecies, viz. Common Sulphur, and Volcanic Sulphur.

First Subspecies.

Common Sulphur.

Gemeiner Natürlicher Schwefel, *Werner.*

This species is divided into two kinds, Compact Common Sulphur, and Earthy Common Sulphur.

First Kind.

Compact Common Sulphur.

Sulphur, *Plin.* Hist. Nat. lib. xxxv. (ed. Bip. vol. v. p. 322.)—Sulphur nativum purum flavum, *Wall.* t. ii. p. 123.—Soufre,

Romé

Romé de Lisle, t. i. p. 28. *Id. De Born*, t. ii. p. 91.—Natürlicher Schwefel, *Wid.* s. 646. *Id. Werner*, Pabst. b. i. s. 368.—Native Sulphur, *Kirw.* vol. ii. p. 69.—Natürlicher Schwefel, *Estner*, b. iii. s. 178. *Id. Emm.* b. ii. s. 189.—Soufre, *Lam.* t. i. p. 68.—Le Soufre natif, *Broch.* t. ii. p. 37.—Soufre, *Haüy*, t. ii. p. 277.–287.—Schwefel, *Reuss*, b. iii. s. 384. *Id. Lud.* b. i. s. 184. *Id. Suck.* 2ter th. s. 38. *Id. Bert.* s. 338. *Id. Mohs*, b. ii. s. 277. *Id. Leonhard*, Tabel. s. 47.—Soufre, *Brong.* t. ii. p. 68.—Schwefel, *Karsten*, Tabel. s. 58. *Id. Haus.* s. 67.—Sulphur, *Kid*, vol. ii. p. 30.—Gemeiner natürlicher Schwefel, *Lenz*, b. ii. s. 1033.—Dichter Schwefel, *Haus.* Handb. b. i. s. 62.—Fester gemeiner Schwefel, *Hoff.* b. ii. s. 253.—Sulphur, *Aikin*, p. 58.

External Characters.

The principal colour is sulphur-yellow, of different degrees of intensity: it occurs also honey-yellow, lemon-yellow, orange-yellow, straw-yellow, and wax-yellow. The honey-yellow sometimes inclines to yellowish-brown, and the straw-yellow to yellowish-grey.

It occurs massive, disseminated, in granular concretions, and crystallised.

Its primitive figure is a pyramid of 107° 19′; 84 24′; basis = 102° 41′ *, Pl. 12. fig. 243.

The following are some of the secondary figures:

1. The pyramid sometimes terminates in a line, Pl. 12. fig. 244. †; sometimes appears truncated on the apices ‡, Pl. 12. fig. 245. or two opposite angles ||, Pl.

* Soufre primitif, Haüy.

† Soufre cuneiforme, Haüy.

‡ Soufre basé, Haüy.

|| Soufre unitaire, Haüy.

Pl. 12. fig. 246.; edge of the common basis is occasionally truncated *, Pl. 12. fig. 247.

2. Pyramid acuminated with four planes, which are set on the lateral planes †, Pl. 12. fig. 248. The apices of the acumination are sometimes truncated ‡, Pl. 12. fig. 249.
3. Double six-sided pyramid, with two opposite broad, and four smaller, lateral planes, and which end in a line ||, Pl. 12. fig. 250.
4. The preceding figure acuminated on the extremities with four planes, and the acuminating planes set on the smaller lateral planes §, Pl. 12. fig. 251.
5. In delicate acicular crystals.

The crystals are middle-sized, small, and very small, seldom large.

The surface of the crystals is generally smooth, seldom drusy.

Internally it varies from shining to glimmering, and the lustre is intermediate between adamantine and resinous.

The cleavage is prismatic, and axifrangible.

The fracture is uneven, inclining sometimes to splintery, sometimes to imperfect conchoidal.

The fragments are angular, and blunt-edged.

It is translucent; the crystals are semi-transparent and transparent, and they refract double.

It is harder than talc, and sometimes even harder than gypsum.

It

* Soufre prisme, Haüy.

† Soufre diodecaedre, Haüy.

‡ Soufre octodecimal, Haüy.

|| Soufre emoussé, Haüy.

§ Soufre unibinaire, Haüy.

It is brittle, and easily-frangible.

When rubbed, it exhales a faint sulphureous smell, and becomes resino-electric.

Specific gravity 1.9, 2.1, *Mohs.*

Chemical Characters.

It is easily inflammable, burning with a lambent bluish flame, and a suffocating odour.

Geognostic Situation.

Common sulphur occurs in considerable abundance in primitive mountains, in a state of combination with metals, forming the different genera of Pyrites, Glance and Blende; but it rarely appears pure or uncombined: while in secondary mountains, it is more abundant in the pure uncombined state than in combination with metals. It is also met with in alluvial districts, particularly near sulphureous springs. The primitive rocks in which common native sulphur occurs, are mica-slate and porphyry; and the most frequent of the secondary rocks in which it is contained, are gypsum, clay, marl, and limestone. Its mode of distribution in rocks varies: in primitive rocks it has been hitherto found only in beds and veins; in secondary mountains in beds, imbedded masses, disseminated, in veins, and lining the walls of drusy cavities.

Geographic Situation.

Europe.—In the island of Iceland, where it occurs in considerable quantity, it is associated with gypsum, or in crusts investing alluvial substances. Near Kracau in Poland, its accompanying rocks are bluish-grey marl, gypsum, limestone, and occasionally selenite, and rarely celestine,

tine, and brown and black coal; but it is not intermixed indiscriminately with all these rocks, being in general inclosed in the marl and gypsum, in masses, from the size of a man's head to that of a pea, or lining the walls of drusy cavities. Very superb specimens of crystallized sulphur are found at Conil, near Cape Trafalgar; the strata of the district are grey gypsum and clay, and in these are large drusy cavities, which, when first opened, are found filled with a yellowish sulphureous water, and their sides are lined with fine crystals of calcareous-spar, and beautiful and large crystals of common sulphur. Sicily is rich in common sulphur, which occurs in layers, imbedded masses, or in drusy cavities in sandstone, but most frequently and abundantly in secondary gypsum. A similar formation to that of Sicily occurs at Urbino in the Papal States. In Arragon in Spain, sulphur occurs in beds, from three to four inches thick, in a secondary formation of alternate beds of gypsum, selenite, and compact slaty marl: the same formation appears to occur in Murcia. Sulphur frequently occurs disseminated in the gypsum of the north of Germany, as at Lauenstein in Hanover; massive and crystallized varieties are collected in gypsum in the glaciers of Pesay in Switzerland; it is sometimes met with in drusy cavities in flint at Polignis, in the department of Jura: disseminated through sandstone at Buodoshegy in Transylvania; intermixed with red manganese at Kapnic; and with red orpiment at Felsobanya: in veins of copper-pyrites that traverse granite at Schwartswald in Swabia: in mica-slate at Glasshütte, near Schemnitz in Hungary; and a very new formation is that which occurs in superimposed crystals on bituminous-wood, or earth-coal, in Thuringia.

Asia.—It occurs in the gold mines of Catharinenburg, and the galena veins in the Uralian Mountains in Siberia.

Africa.

Africa.—In considerable abundance on Mount Atlas, in northern Africa; and imbedded in basalt in the Isle of Bourbon.

America.—In California; on sides of springs in the United States; between Alausi and Ticsau, in Quito in Peru, in mica-slate, in a bed associated with quartz; and it is said also in primitive porphyry in that country.

Second Kind.

Earthy Common Sulphur.

Erdiger gemeiner Natürlicher Schwefel, *Werner*

Soufre pulverulent, *Haüy*.

Erdiger gemeiner Schwefel, *Hoff.* b. iii. s. 261.

External Characters.

Its colour is pale straw-yellow.

It occurs massive and disseminated.

Internally it is dull.

The fracture is fine earthy.

The fragments are indeterminate angular and blunt-edged.

It is opaque.

It does not soil.

It alternates from very soft to friable.

Geognostic and Geographic Situations.

It occurs in drusy cavities in flint, and along with the compact varieties in gypsum, and other rocks.

Second

Second Subspecies.

Volcanic Sulphur.

Vulcanischer Natürlicher Schwefel, *Werner.*

Le Soufre natif volcanique, *Broch.* t. ii. p. 42.—Vulcanischer Schwefel, *Reuss,* b. iii. s. 90. *Id. Mohs,* b. ii. s. 282. *Id. Leonhard,* Tabel. s. 47. *Id. Karsten,* Tabel. s. 38. *Id. Lenz,* b. ii. s. 1038. *Id. Hoff.* b. iii. s. 262.—Volcanic Sulphur, *Aikin,* p. 58.

External Characters.

Its colour is pale sulphur-yellow, which sometimes passes into grey.

It occurs massive, stalactitic *, vesicular, corroded, perforated; and crystallised in pyramidal figures.

It is glistening, and the lustre is resinous, inclining to adamantine.

The fracture is coarse and small grained uneven.

The fragments are indeterminate angular, and blunt-edged.

It is slightly translucent.

In other characters it agrees with the preceding subspecies.

Geognostic and Geographic Situations.

Europe.—It occurs only in volcanic countries, where it is found more or less abundantly amongst lavas. Solfatara, in

* Spallanzani observed stalactites of volcanic sulphur, three feet long and two inches thick, in a grotto formed in the walls of the crater of Vulcano.

in the vicinity of Vesuvius, is one of the most famous repositories of volcanic sulphur, and it is there collected in considerable quantities, for the purposes of commerce. It is also found in the island of Iceland, and in such quantity that it is collected as an article of trade; on Ætna; and in the Lipari Islands.

Africa.—Island of Teneriffe, and island of Bourbon.

America.—In the islands of St Lucia, St Domingo, Martinique, and Guadaloupe.

Asia.—Island of Java.

Uses.

When burnt, it affords sulphuric acid; it enters into the composition of gunpowder; is used in various metallurgic processes, and in bleaching; it forms a constituent part of some cements; is employed in taking casts; and is an article in the materia medica.

CLASS IV.

CLASS IV.

INFLAMMABLE MINERALS.

ORDER I.—RESIN *.

GENUS I.—HONEYSTONE.

Crystal-Harz, *Mohs.*

THIS Genus contains one Species, viz. Pyramidal Honeystone.

1. Pyramidal Honeystone.

Pyramidales Crystal-Harz, *Mohs.*

Honigstein, *Werner.*

Id. Wid. s. 639.—Succin transparent en Cristaux octaedres, *De Born,* t. ii. p. 90.—Mellilite, *Kirw.* vol. ii. p. 68.—Honigstein, *Emm.* b. ii. s. 86.—La Pierre de Miel, ou le Mellite, *Broch.* t. ii. p. 73. *Id. Haüy,* t. iii. p. 335.—Honigstein, *Reuss,* b. ii. s. 52. *Id. Leonhard,* Tabel. s. 47. *Id. Karsten,* Tabel. s. 58. —Mellite, *Brong.* t. ii. p. 52.—Mellilite, *Kid,* vol. ii. p. 39. —Honigstein, *Lenz,* b. ii. s. 1100. *Id. Haus.* Handb. b. iii. s. 811. *Id. Hoff.* b. iii. s. 334.—Mellite, *Aikin,* p. 63.

External

* So named from the resinous aspect of the minerals of the order.

External Characters.

Its colour is honey-yellow, which on the one side inclines to wax-yellow, and on the other passes into reddish brown and hyacinth-red.

It rarely occurs massive, but very distinctly crystallised.

Its primitive figure is a pyramid of 118° 4′, and 93° 22′. The following are some of the secondary figures:

1. The primitive pyramid truncated on the apices.
2. Pyramid truncated on the apices, and on the angles of the common base.
3. When the truncations on the angles increase in magnitude, there is formed a low rectangular four-sided prism, rather flatly acuminated, with four planes, which are set on the lateral edges.
4. When the truncations on the angles become so large that the edges of the common basis are changed into angles, an irregular rhomboidal dodecahedron is formed.
5. The angles on the common base flatly bevelled, and the bevelling planes set on the lateral planes.

The crystals are middle-sized, and small.

Externally it is smooth and splendent.

The lustre is shining or splendent, and intermediate between vitreous and resinous.

The cleavage is pyramidal.

The fracture is perfect and flat conchoidal.

The fragments are indeterminately angular, and rather sharp-edged.

It is semi-transparent, or translucent, and refracts double, in the direction of the pyramidal plane.

It is harder than gypsum, but not so hard as calcareous-spar.

It is brittle, and easily frangible.

Specific gravity, 1.4, 1.6, *Mohs*; 1.560, 1.593, *Breithaupt.*

Chemical Characters.

Before the blowpipe it becomes white and opaque, with black spots, and is at length reduced to ashes: when heated in a close vessel, it becomes black.

Physical Character.

It becomes slightly resino-electric by friction.

Constituent Parts.

Alumina, - - -	16
Mellilitic Acid, -	46
Water of crystallization, -	38
	100

Klaproth, Beit. b. iii. s. 114.

Geognostic and Geographic Situations.

It occurs superimposed on bituminous wood and earth-coal, and is usually accompanied with sulphur. It has been hitherto found only at Artern in Thuringia. The Swiss locality mentioned by some authors is very dubious.

Observations.

1. Its name is borrowed from its honey-yellow colour.
2. It differs from *Amber*, in being crystallised, refract-

ing double, and in being harder, heavier, and less powerfully electric.

3. It is chemically distinguished from *Amber:* on burning coal amber intumesces, and diffuses a fragrant odour; Honeystone, on the contrary, becomes white, without intumescence or fragrant odour.

GENUS II.—MINERAL RESIN.

Erd-Harz, *Mohs.*

This genus contains two species, viz. Yellow Mineral Resin, and Black Mineral Resin. * Retin Asphalt. ** Fossil Copal.

1. Yellow Mineral Resin or Amber.

Gelbes Erdharz, *Mohs.*

This species is subdivided into three subspecies, viz. White Amber, Yellow Amber, Earthy Amber.

First Subspecies.

White Amber.

Weisser Bernstein, *Werner.*

Id. Werner, Pabst. b. i. s. 367.—Le Succin blanc, *Broch.* t. ii. p. 69.—Weisser Bernstein, *Reuss,* b. iii. s. 166. *Id. Leonhard,*

hard, Tabel. s. 47. *Id. Karsten,* Tabel. s. 58. *Id. Haus.* s. 117. *Id. Lenz,* b. ii. s. 1093. *Id. Haus.* Handb. b. i. s. 93. *Id. Hoff.* b. iii. s. 326.

External Characters.

Its colour is frequently dark yellowish-white, which sometimes inclines to straw-yellow.

It occurs massive, or inclosed in the yellow subspecies.

It is glistening, approaching to shining, and the lustre is resinous.

The fracture is conchoidal, but not so perfect as in the yellow subspecies.

The fragments are indeterminate angular, and sharp-edged.

It is only translucent.

In other characters, it resembles the following subspecies.

Observations.

Its white colour, and inferior lustre and transparency, distinguish it from *Yellow Amber.*

Second Subspecies.

Yellow Amber.

Gelber Bernstein, *Werner.*

Id. Werner, b. i. s. 367.—Le succin jaune, *Broch.* t. ii. p. 70.—Gelber Bernstein, *Reuss,* b. iii. s. 169. *Id. Leonhard,* Tabel. s. 47. *Id. Karsten,* Tabel. s. 58. *Id. Haus.* s. 117. *Id. Lenz,* b. ii. s. 1095. *Id. Haus.* Handb. b. i. s. 93. *Id. Hoff.* b. iii. s. 325.

External Characters.

Its colour is honey-yellow, and frequently it passes on the one side into wax-yellow, yellowish and reddish-brown, and this last into hyacinth-red; and on the other side sometimes into green. It is generally of a darker colour externally than internally.

It generally occurs in broad and blunt angular pieces, having a rough uneven surface; sometimes disseminated. Often with inclosed insects.

Externally it is generally dull; internally it is splendent and shining, and the lustre is resinous.

The fracture is large and perfect conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is almost always transparent.

It is harder than gypsum, but not so hard as calcareous-spar. It is softer than honeystone.

Its streak is white.

It is rather brittle, and easily frangible.

Specific gravity 1.0, 1.1, *Mohs.*

Chemical Character.

It burns with a yellow-coloured flame, and fragrant odour, at the same time intumescing, but scarcely melting.

Physical Characters.

When rubbed, it gives out an agreeable smell, and becomes strongly resino-electric. This latter property was known

known to the ancients, who termed amber *electrum*; from whence is derived the word *electricity* *.

Constituent Parts.

It is composed of Carbon, Hydrogen, and Oxygen. An acid named *Succinic* is obtained from it by distillation.

Geognostic

---

* The appearances and electrical property of amber are so often alluded to in ancient authors, that it is not necessary to shew by quotations that they were familiar with that substance; and though the history of its origin is much involved in fable, yet they seem to have had some idea that it was found in the north of Europe:—

———————— Κελτοὶ δ' ἐπὶ βάξιν ἔθεντο
Ὡς ἄρ' Ἀπόλλωνος τάδε δάκρυα Λητοΐδαο,
Ἐμφέρεται δίναις· ἅτε μυρία χεῦε παροιθεν·
Ἦμος Ὑπερβορέων ἱερὸν γένος εἰσαφίκανεν (*a*).

Pliny says, in speaking of amber, "Certum est gigni in insulis Septentrionalis Oceani (*b*):" and, in another place, "Ab adverso (Britanniarum) in Germanicum mare sparsæ Glessariæ (insulæ); quas Electridas Græci recentiores appellavere, quod ibi electrum nasceretur (*c*)." In another place, he says, that in the spring-time it was washed on a part of the coast of Germany, from an island in the North Sea; concluding with these words: "Incolas pro ligne ad ignem uti eo, proximisque Teutonis vendere (*d*)." From the foregoing passages, it seems very probable, that the opinion of Solinus respecting the origin of amber is correct: he says that it was originally brought from the northern sea, through Pannonia and Illyria, into the country bordering on the river Po; and hence Phaeton's sisters, or the poplars of that river, are fabled to have wept amber; this substance being easily mistaken for a vegetable gum.—*Kid's* Mineralogy, vol. ii. p. 37.

(*a*) Apoll. Rhod. lib. iv. lin. 611,—614.

(*b*) Nat. Hist. t. vi. p. 266. ed. Brot.

(*c*) Hist. Nat. lib. iii.

(*d*) Hist. Nat. lib. xxxvii.

Geognostic Situation.

This mineral occurs in beds of bituminous-wood * and moor-coal; also in a conglomerate formed by the aggregation of fragments on the sea shores; in sandy soil; frequently floating on the sea; and it is said to have been observed imbedded in secondary limestone.

Geographic Situation.

Europe.—It is thrown up by the sea on the coasts of Norfolk, Suffolk, and Essex, and occurs imbedded in a gravel-pit at Kensington, near London. It occurs in greatest quantity in East Prussia; also on the coast of the Baltic, in Courland, Liefland, Russia, Swedish Pomerania, and West Prussia. It is found in a sandy soil in Poland, at a great distance from the sea, where it is intermixed with cones of the Pinus abies. It occurs also in France, on the coasts of Sicily, Spain, near Alicant, and in the Asturias, in one of which it is said to occur imbedded in limestone; in the kingdom of Saxony; and in Switzerland, Moravia, Austria, and the Bannat of Temeswar.

Asia.—It is found imbedded in coal at the mouth of the Jenisei, in Siberia; in a similar situation in the Bay of Penschincha, in the same country; and is one of the mineral productions of China.

America.—It is found in different places in the United States; thus it occurs in New Jersey, in Croswick's Creek, four miles from Trenton, in alluvial soil. It occurs in grains, or in small masses, seldom exceeding an inch in length; it rests on bituminous wood, or even sometimes penetrates it, and is sometimes connected with pyrites. The bed

* It would appear, that many of the fossilised trees with which the amber is associated, are of the palm tribe.

bed of bituminous wood which contains the amber, rests on a coarse ferruginous sand, and is covered by a soft bluish clay, inclosing masses of iron-pyrites. Above the clay is a bed of sand. Amber also occurs near Woodbury in the same state, in large plates in marl; also at Cambden, opposite Philadelphia *. Grains and masses of amber occur in brown coal in Greenland.

Africa.—It is said to occur on the coast of Madagascar.

Uses.

On account of its beautiful colour, great transparency, and the fine polish it receives, it is considered as an ornamental stone, and is cut into necklaces, bracelets, snuff-boxes, and other articles of dress. Before the discovery of the diamond, and the other precious stones of India, it was considered to be the most precious of jewels, and was employed in all kinds of ornamental dress. Great quantities of it are annually exported from Dantzig to Constantinople, the Levant, Persia, and France. The most considerable purchasers of amber are the merchants of Armenia and Greece; but it is still uncertain how they dispose of it. It is conjectured by some, that it is purchased from them by pilgrims, previous to their journey to Mecca, and that on their arrival there, it is burnt in honour of the prophet Mahomet. It is also an important article of exchange in Africa. When dissolved in oil, it forms a species of varnish, named *Amber varnish.*

Observations.

1. The only minerals with which it is likely to be confounded, are *Honeystone* and *Fossil Copal:* its strong electrical

* Cleaveland's Mineralogy.

electrical property, and single refracting power, distinguish it from Honeystone; and its colour and difficult fusibility from Fossil Copal.

2. It frequently includes bodies of different kinds, as grains of sand, pieces of iron-pyrites, and also insects of the genera *Staphylinus*, *Blatta*, *Termes*, which are not natives of Europe; and also European insects, particularly the *Culex pipiens*. Born mentions a specimen of amber, containing a species of Gorgonia: another author describes a specimen containing the seed-vessels of the *Pinus abies*: in some cabinets, there are specimens including pinnated leaves, resembling those of ferns, and other specimens inclosing drops of transparent water.

3. Masses of considerable size have been met with in the amber-mines on the coasts of the Baltic. Thus, in the year 1576, a piece of amber weighing 11 pounds, was found in Prussia, and sent to Prague, as a present to Rodolph II.; and a few years ago, a mass, weighing upwards of 13 pounds, and whose contents amounted to 318$\frac{5}{4}$ cubic inches, was dug up in the same country. Five thousand dollars are said to have been offered for this latter mass; and the Armenian merchants assert, that in Constantinople it would sell for thirty or forty thousand dollars *.

4. Various conjectures have been proposed in regard to its origin and formation. By some, it is held to be a vegetable gum or resin, altered by processes unknown to us: others consider it a variety of mineral oil, thickened by absorption of oxygen; and it has also been alleged to be inspissated mineral-oil.

5. The

* Neues allgemeines Journal der Chemie, b. i. s. 224.

5. The pitch-coal sometimes found along with it, is by the amber-diggers named *Black Amber*, and is sold at a great price.

6. This mineral is sometimes named *Succinum*, from the word *succus*, it having been conceived that amber was an inspissated juice. Thus, Pliny remarks, "Arboris succum esse prisci nostri credidere, ob id *succinum* appellantes *." It was also by Pliny and other ancient writers, named *Electrum*, from its resemblance in colour to the metallic alloy of the ancients, which consisted of gold and silver, and was called by the same name; or from Ἠλεκτωρ, one of the names of the sun †.

7. When one part of the empyreumatic oil obtained by distilling mineral pitch, is boiled several times with one and a half parts of turpentine, a compound is formed, which bears a great resemblance to amber, and which is frequently cut into necklaces, and other ornaments, and sold as true amber.

Third Subspecies.

Earthy Amber.

Bernerde, *Werner*.

Bernerde, *Hoff.* b. iv. s. 171.

External Characters.

Its colour is pale yellowish-brown, which inclines to honey-yellow, but has always a considerable intermixture of grey.

It

* Plin. Hist. Nat. t. vi. p. 266. ed. Brot.

† Kid's Mineralogy, vol. ii, p. 36.

It is friable, and rarely inclines to compact. It is composed of dull dusty particles, which are either more or less coherent, or are loose.

It soils slightly.

Feels fine, but meagre.

Nearly supernatant.

Chemical Character.

It burns like amber.

Geognostic and Geographic Situations.

It occurs imbedded in beds of brown coal and alum-earth, and frequently intermixed with bitumen, near Zittari, and at Muskau in Saxony.

Observations.

Its colour and smell distinguish it from earth-coal.

* Retinite.

Retin-Asphalt, *Hatchett.*

Retin-asphalt, *Hatchett,* in Phil. Trans. for 1804. *Id. Kid,* vol. ii. p. 66.—Erdharze, *Wagner,* in Von Moll's Ephemeriden der Berg und Hüttenkunde, b. iv. s. 20.—Retin-asphalt, *Aikin,* p. 68.—Retinit, *Hoff.* b. iv. s. 173.

External Characters.

Its colours are yellowish, liver, and reddish brown, passing into brownish and hyacinth red, and inclining to orange-yellow: the yellowish-brown passes into honey-yellow,

yellow, and the liver-brown often inclines to green. The colours are generally mixed with grey, and frequently may occur in the same specimen.

It occurs massive, in angular pieces, and in thick crusts.

The external surface is generally rough, and is often cracked.

The lustre varies from shining to glistening, and is resinous.

The fracture is imperfect conchoidal or uneven.

It alternates from semitransparent to translucent on the edges.

It is soft, and very soft.

It is rather brittle and easily frangible.

When first taken from its repository, is elastic, flexible, and on exposure becomes rigid: it is even sometimes rigid when first dug up.

Specific gravity, 1.135, *Hatchett*; 1.126, *Steffens*.

Chemical Characters.

When placed on a hot iron it melts, smokes, and burns with a bright flame, giving out a fragrant odour; it is soluble in potash, and partly so in spirit of wine.

Constituent Parts.

Resin, - -	55	91
Asphalt, - -	42	9
Earth, - -	3	
	100	100
	Hatchett, Phil. Trans. for 1804.	*Bucholz*.

Geognostic and Geographic Situations.

It is found at Bovey Tracey in Devonshire, adhering to brown-coal. A similar mineral has been met with near Naumberg

Naumberg in the circle of Saale at Langenbogen, near Halle; at Wildshut in the Innviertel in Austria; and at Uttigshof in Moravia.

Observations.

1. This curious mineral was first discovered, described, and analysed by Mr Hatchett.

2. Colour, fracture, softness, and easy frangibility characterise this mineral, and also distinguish it from amber, to which it is more nearly allied than to mineral-pitch.

3. It has been described under the name *Mineral Caoutchouc*.

** Fossil Copal.

Fossil Copal, or Highgate Resin, *Aikin*.

External Characters.

Its colour is pale muddy yellowish-brown.
It occurs in irregular roundish pieces.
The lustre is resinous.
It is semi-transparent.
It is brittle.
It yields easily to the knife.
Specific gravity 1.046.

Chemical Characters.

It gives out a resinous aromatic odour when heated; melts into a limpid fluid; takes fire when applied to the flame of a candle; and burns away entirely before the blowpipe. Insoluble in potash ley.

Geognostic

Geognostic and Geographic Situations.

It is found in the bed of blue clay at Highgate, near London.

Observations.

The preceding description of this mineral is that of Mr Aikin, which I have extracted from his Manual of Mineralogy.

2. Black Mineral Resin.

Schwarzes, Erd-Harz, *Mohs.*

This species is divided into three subspecies, viz. Naphtha, Mineral Oil or Petroleum, and Mineral Pitch or Bitumen.

First Subspecies.

Naphtha.

Ναφθα of the ancient Greeks.—Vid. *Plin.* Hist. Nat. t. ii. (ed. Bip.) 1. p. 198.—Bitumen candidum? *Plin.* Hist. Nat. xxxv. (ed. Bip. v. p. 324.)—Bitumen Naphtha, *Wall.* Syst. Min. t. ii. p. 98.—Naphte, *Romé de Lisle,* t. ii. p. 192. *Id. De Born,* t. ii. p. 75. *Id. Wid.* s. 617. *Id. Kirw.* vol. ii. p. 42.—Bitumine liquide blanchâtre, *Haüy,* t. iii. s. 312.—Le Naphte, *Broch.* t. ii. p. 59.—Naphtha, *Reuss,* b. iii. 3. s. 96.—Bitume Naphte, *Brong.* t. ii. p. 19.—Naphtha, *Leonhard,* Tabel. s. 48. —Liquides Bergöl, *Karsten,* Tabel. s. 58.—Naphtha, *Haüy,* s. 117. *Id. Kid,* vol. ii. p. 61, *Id. Lenz,* b. ii. 1045. *Id. Haus.* Handb. b. i. s. 89. *Id. Aikin,* p. 59.

External

External Characters.

Its colours are yellowish-white, yellowish-grey, and wine-yellow.

It is perfectly fluid.

It is shining and resinous.

It feels greasy.

It exhales an agreeable bituminous smell.

Specific gravity 0.7.

Chemical Characters.

It takes fire on the approach of flame, affording a bright white light.

Constituent Parts.

It is a compound of Carbon, Hydrogen, and a little Oxygen.

Geognostic and Geographic Situations.

This mineral is seldom found in a pure state. It is said to occur in considerable springs on the shores of the Caspian Sea; in the Caucasus; Japan; Persia; and France; also in Sicily; and some districts in Italy, as Calabria, Modena, and Parma. These springs issue from rocks of different kinds, as limestone, marl, and sandstone.

Uses.

In Persia, Japan, and some parts of Italy, where it occurs in considerable quantity, it is used in lamps, in place of oil, for lighting streets, churches, &c. When mixed with certain vegetable oils, it forms an excellent

 varnish;

varnish; and formerly it was employed as a vermifuge medicine.

Second Subspecies.

Mineral Oil, or Petroleum.

Erdöl, *Werner.*

Bitumen liquidum, *Plin.* Hist. Nat. xxxv.—Maltha tarde fluens, *Wall.* t. ii. p. 92.—Petrole, *Romé de Lisle*, t. ii. p. 591. *Id. De Born*, t. ii. p. 75.—Petrol, *Kirw.* vol. ii. p. 43. *Id. Estner*, b. iii. s. 97. *Id. Emm.* b. ii. s. 43.—Bitumine liquide noirâtre, *Haüy*, t. iii. p. 312.—L'Huile minerale commune, ou le Petrol, *Broch.* t. ii. p. 59, 60.—Gemeines Bergöl, *Reuss*, b. iii. s. 96.–101. *Id. Mohs*, b. ii. s. 302. *Id. Leonhard*, Tabel. s. 48.—Bitumen Petrole, *Brong.* t. ii. p. 24.—Verdicktes Bergöl, *Karsten*, Tabel. s. 58.—Steinöl, *Haus.* s. 117.—Petroleum, *Kid*, vol. ii. p. 62.—Bergöl, *Lenz*, b. ii. s. 1047.—Flussiges Bergtheer, *Haus.* Handb. b. i. s. 89.—Erdöl, *Hoff.* b. iii. s. 266.—Petroleum, *Aikin*, p. 59.

External Characters.

Its colour is dark blackish-brown, which sometimes inclines to green.

It is fluid, but approaches more or less to the viscid state.

It is shining and resinous.

It feels greasy.

It is semi-transparent, translucent, and opaque.

It exhales a strong bituminous odour.

It is so light as to swim on water.

Chemical Characters.

It inflames easily, emits a bluish flame, and yields a smoke

smoke more or less opaque, according to the density of the oil, and sometimes leaves a very small earthy residue.

Constituent Parts.

It is composed of Carbon, Hydrogen, and a little Oxygen.

Geognostic Situation.

It generally flows from rocks of the coal formation, and usually from the immediate vicinity of beds of coal; also from limestone rocks. It occurs in marshes, on the surface of spring water; or it flows or trickles unmixed from its repository.

Geographic Situation.

Europe.—Oozing from secondary rocks at St Catherine's Well, near Edinburgh, and in the island of Pomona, one of the Orkneys. Filling cavities and veins in limestone at Pitchford and Madeley in Shropshire. Several springs of this mineral occur in France, as at Gabian in Herault; in Auvergne; and at Pechelbrunn in Alsace, the sandstone is very highly impregnated with it. It is also found on the Lake Tegern, in Bavaria; near Neufschatel in Switzerland; at Amiano, twelve leagues from Parma; in Mount Zibio, near Modena; and a spring has been seen rising from the bottom of the sea in the Bay of Naples, which pours out much mineral oil. It is also met with in Sicily; in the salt-mines in Transylvania; in Gallicia; and in Moldavia, springs of petroleum flow from a track where there is an alternation of beds of sandstone, marl, gypsum, and rock-salt.

Asia.—On the shores of the Caspian Sea; it is also met with at Semenowa, in Siberia, and near the stream of Taliza, in the Altain Mountains. There are very productive mines of mineral oil in the kingdom of Ava: about five hundred shafts or pits are sunk through soil, sandstone, slate-clay, and coal, and it is from the coal that the oil issues. When drawn from the pit, it is much mixed with water, from which it is separated by decantation. These mines afford annually 400,000 hogsheads of petroleum. Mineral oil is also met with in Persia, and Japan.

America.—On the banks of the Ohio; and, according to travellers, many springs in Kentucky, Pennsylvania, and New-York, carry along with them quantities of this mineral. It is also a production of Newfoundland, and of the island of Trinidad.

Uses.

In Piedmont, Persia, Japan, and other countries, it is used in lamps, in place of oil, for lighting streets and churches. It is also used for warming rooms, when mixed with earth, and inflamed. It is occasionally employed instead of common tar, to preserve wood from decay, and from worms; also as a varnish; and in the composition of fire-works.

Third Subspecies.

Mineral Pitch, or Bitumen.

This species is divided into three kinds, viz. Earthy Mineral Pitch, Slaggy Mineral Pitch, and Elastic Mineral Pitch.

First Kind.

Earthy Mineral Pitch.

Erdiges Erdpech, *Werner.*

Semi-compact Mineral Pitch, or Maltha, *Kirw.* vol. ii. p. 46.—La Poix minerale terreuse, *Broch.* t. ii. p. 65.—Erdiges Bergpech, *Reuss,* b. iii. s. 107. *Id. Lud.* 1r th. s. 193. *Id. Suck.* 2ter th. s. 45. *Id. Bert.* s. 342. *Id. Mohs,* b. ii. s. 307. *Id. Leonhard,* Tabel. s. 48.—Thonartiges Erdpech, *Karsten,* Tabel. s. 58.—Erdiges Erdpech, *Haus.* s. 117. *Id. Lenz,* b. ii. s. 1051.—Cohesive Mineral Pitch, *Aikin,* p. 60.

External Characters.

Its colour is blackish-brown.
It occurs massive.
It is faintly glimmering, inclining to dull.
The fracture is earthy, or small grained uneven.
The fragments are blunt-edged.
The streak is shining and resinous.
It is very soft.
It is sectile.
It feels greasy.
It is so light as almost to swim in water.
It smells strongly bituminous.

Chemical Characters.

It burns with a clear and brisk flame, emits an agreeable bituminous smell, and deposites much soot.

Constituent

Constituent Parts.

Inflammable Matter, -	50.50
Silica, - - -	28.50
Alumina, - - -	15.50
Lime, - - - -	4.25
Oxide of Iron, - -	1.19

Lenz, Min. b. ii. s. 1052.

Geognostic and Geographic Situations.

It occurs in the Iberg in the Hartz, along with slaggy mineral pitch, in veins that traverse grey-wacke; at Prague, in calcareous-spar veins that traverse transition greenstone; at Voltrarers in Neufchatel; it is said also at Carharrack in Cornwall; and in the pitch lakes of Trinidad.

Second Kind.

Slaggy Mineral Pitch, or Asphaltum.

Schlackiges Erdpech, *Werner*.

Ασφαλτος of the Greeks, *Aristotelis* Lib. de Min. Ascult. expl. a J. Beckman, Gott. 1786, 4to, p. 280.—Bitumen, *Plin.* Hist. Nat. xxxv.—Bitumen solidum coagulatum friabile, Asphaltum, *Wall.* t. ii. p. 93.—Asphalte, ou Bitume de Judée, *Romé de Lisle*, t. ii. p. 592. *Id. De Born*, t. ii. p. 78.—Bergpech, ou Judenpech, *Wid.* s. 624.—Asphaltum, or Compact Mineral Pitch, *Kirw.* vol. ii. p. 46.—Asphaltum, *Hatchett*, Lin. Trans. vol. iv. p. 132.—Schlackiges Erdpech, *Estner*, b iii. s. 110. *Id. Emm.* b. ii. s. 50.—Asphalte, *Lam.* t. ii. p. 533. 635.—

Bitume

Bitume solide, *Haüy*, t. iii. p. 313.—La Poix minerale scoriacée, *Broch.* t. ii. p. 66.—Schlackiges Bergpech, *Reuss*, b. iii. s. 113. *Id. Lud.* b. i. s. 193. *Id. Suck.* 2ter th. s. 48. *Id. Bert.* s. 343. *Id. Mohs*, b. ii. s. 307.—Bitume asphalte, *Brong.* t. ii. p. 25. —Schlackiges Erdpech, *Leonhard*, Tabel. s. 48. *Id. Karsten*, Tabel. s. 58. *Id. Lenz*, b. ii. s. 1052.—Schlackiges Erdpech, *Haus.* Handb. b. i. s. 85. *Id. Hoff.* b. iii. s. 274.—Compact Mineral Pitch, *Aikin*, p. 60.

External Characters.

Its colour is pitch-black, which sometimes approaches to velvet-black.

It occurs massive, disseminated, sometimes globular, reniform, and stalagmitic.

Externally and internally it is splendent and shining, and the lustre is resinous.

The fracture is either imperfect, or very perfect conchoidal.

The fragments are pretty sharp-edged.

It is soft, passing into very soft.

It is opaque.

It is sectile.

It retains its lustre in the streak.

It is easily frangible.

It feels greasy.

Specific gravity 1.0, 1.159,

When held between the fingers emits a bituminous smell.

Constituent

Constituent Parts.

Slaggy Mineral Pitch from Avlona in Albania.

Carbonated Hydrogen, -	36	cubic inches
Bituminous Oil, -	32	grains.
Ammoniacal Water, -	6	
Carbon, - -	30	
Silica, -	7.50	
Alumina, - -	4.50	
Lime, - -	0.75	
Oxide of Iron, -	1.25	
Oxide of Manganese, -	0.50	

Klaproth, Beit. b. iii. s. 318.

The above quantities were obtained from 100 grains, and are partly products, partly educts.

Geognostic and Geographic Situations.

Europe.—It occurs in veins in reniform and imbedded masses in secondary limestone in Fifeshire; in clay ironstone in East Lothian; in veins, at Haughmond Hill in Shropshire; and in mineral veins in Cornwall. Near Grund in the Hartz, along with sparry iron, brown iron-ore, and heavy-spar; at the Iberge the galena is intermixed with it; in veins, along with calcareous-spar and brown iron-ore, at Kamsdorf in Saxony; at Violenberg, near Grund, in pieces the size of a hen's egg, mixed with slaty glance-coal, in veins composed of compact brown iron-ore, cellular quartz, and straight lamellar heavy-spar. It is also met with at Nordberg and Dannemora in Sweden; Morsfeldt in the Palatinate; in the quicksilver mines of Deux Ponts; incrusting caleedony in Auvergne; in Salzburg;

burg; Switzerland; Avlona in Albania, in thick beds in sandstone; and Semenowa in Russia.

Asia.—It is met with in the mountains of Caucasus; in abundance at the Lake of Asphaltes in Judea, where it occurs in masses on the shores, or in pieces floating on the surface of the water, appearing to be derived from strata or rocks of slaggy mineral pitch in the neighbourhood; also on the Tigris and Euphrates, in the Uralian Mountains.

America.—Mexico. In the Island of Trinidad, there is a lake three miles in circumference, covered with a bituminous substance, of the nature of slaggy mineral pitch, and considerable quantities of this mineral are found in Barbadoes.

Uses.

The Egyptians employed it in the process of embalming bodies *. The Turks quarry it in Albania, and use it, when mixed with common rosin, for paying the bottoms of ships, and for smearing the rigging. The same use is made of the mineral pitch of Trinidad, and it is supposed to protect the bottoms of ships from the attack of the teredo or borer, so frequent in the West Indian seas. The Arabians still use a solution of it in oil to besmear their horse harness, to preserve it from insects. The ancients also

* Rouelle concludes, from experiments which he made on mummies, that the Egyptians employed slaggy mineral pitch in embalming the dead. This operation was performed in three different ways: the first with slaggy mineral pitch alone: the second with a mixture of this bitumen, and a liquor extracted from cedar, called *Cedria*; and the third with a similar mixture, to which resinous and aromatic substances were added.—*Hauy*, Mineralog. t. ii. p. 315, 316.

also used it as an ingredient in mortar; and it is said that the walls of the famous city of Babylon were built with a mortar of this kind. The German translator of J. Bar. de Vignola's *Civil Baukunst*, observes, "I may here also remark, that we find in the accounts of travellers that buildings are often constructed with pitch; and that Peter de Val mentions, that he examined very old buildings, the stones of which were cemented by means of mineral pitch, and which were still very firm, and in good order." Klaproth says, that the slaggy mineral pitch of Avlona burns with a strong and lively flame, and is considered as the principal ingredient in the *Greek Fire*, so much employed in former times.

Observations.

1. The substances described under the names *Asphalt*, *Jews Pitch*, *Mumia mineralis*, *Mineral Pitch*, *Bitumen of Judea*, principally belong to this subspecies, although under these names, by some mineralogists, Earthy Mineral Pitch is understood.

2. Gagat or Jet, is a variety of pitch coal, and therefore cannot be arranged under this species.

3. The term *Asphalt*, sometimes applied to this substance, is derived from the name of the Lake of Judea, where it occurs in abundance.

Third Kind.

Elastic Mineral Pitch.

Elastiches Erdpech, *Werner.*

Elastic Bitumen, *Hatchett*, Linn. Trans. vol. iv. p. 146. &c.—Mineral Cahoutchouc, *Kirw.* vol. ii. p. 48.—Elastiches Erdpech,

pech, *Estner*, b. iii. s. 106. *Id. Emm.* b. iii. s. 106.—Cahoutchou fossile, *Lam.* t. ii. p. 540.—La Poix minerale elastique, *Broch.* t. ii. p. 64.—Bitume elastique, *Haüy*, t. iii. p. 313, 314.—Elastiches Bergpech, *Reuss*, b. iii. s. 110. *Id. Lud.* b. i. s. 192. *Id. Suck.* 2ter th. s. 46.—Elastisches Federharz, *Bert.* s. 343.—Elastisches Erdpech, *Mohs*, b. ii. s. 304. *Id. Leonhard*, Tabel. s. 48. *Id. Haus.* s. 117. *Id. Karsten*, Tabel. s. 58. *Id. Lenz*, b. ii. s. 1052.—Dichter Elaterite, *Haus.* Handb. b. i. s. 87.—Elastisches Erdpech, *Hoff.* b. iii. s. 271. —Elastic Mineral Pitch, *Aikin*, p. 60.

External Characters.

Its colours are blackish-brown, sometimes inclining to brownish-black, sometimes to reddish-brown.

It occurs massive, reniform, and sometimes with impressions.

Internally it is shining and glistening, and the lustre is resinous.

The fracture is curved slaty, or conchoidal.

The fragments are indeterminately angular, and also slaty.

It is translucent on the edges.

It is shining in the streak.

It is very soft.

It is perfectly sectile.

It is elastic flexible.

It is light, verging on swimming.

Specific gravity from 0.9053 to 1.233, *Hatchett*. 0.930, *La Metherie*. 0.9021, *Jordan*.

Constituent

Constituent Parts.

100 Grains afforded the following products and educts:

Carbonated Hydrogen,	38	cubic inches.
Carbonic Acid,	4	
Bituminous Oil,	73	grains.
Acid Water,	1.50	
Carbon,	6.25	
Lime,	2.0	
Silica,	1.50	
Oxide of Iron,	0.75	
Sulphate of Lime,	0.50	
Alumina,	0.25	

Klaproth, Beit. b. iii. s. 112.

Geognostic and Geographic Situations.

It is found in the cavities of a vein in the lead-mine called Odin, which is situated near the base of Mamtor, to the north of Castletown in Derbyshire. The vein traverses limestone, and contains galena or lead-glance, accompanied with fluor-spar, calcareous-spar, quartz, blende, calamine, selenite, and slaggy mineral pitch. It is said to have been discovered at Neufchatel, and in the island of Zante.

Observations.

1. According to Hatchett, a transition is to be observed from Mineral Oil, through Slaggy Mineral Pitch, to Elastic Mineral Pitch.

2. Like the elastic gum called Cahoutchouc, it removes the traces of graphite (black lead), but it at the same time soils the paper a little.

3. The

3. The first account of this mineral was published by Dr Lister in the Philosophical Transactions for 1673. It was found in an old forsaken mine. He calls it a subterraneous fungus, and is uncertain whether it belongs to the vegetable or mineral kingdom; but rather inclines to the former, and hints that it may have grown out of the old birch props used in the mine. It was first accurately examined by Mr Hatchett.

ORDER II.

ORDER *II.—COAL.*

Steinkohle, *Mohs.*

GENUS I.—COAL.

This Genus contains three Species, viz. Brown Coal, Black Coal, and Glance Coal.

1. Brown Coal.

Braun Kohle, *Werner.*

This species is divided into five subspecies, viz. 1. Bituminous Wood, or Fibrous Brown Coal. 2. Earthy Coal, or Earthy Brown Coal. 3. Alum Earth. 4. Common Brown Coal, or Conchoidal Brown Coal; and, 5. Moor Coal, or Trapezoidal Coal.

First Subspecies.

Bituminous Wood, or Fibrous Brown Coal.

Bituminöses Holz, *Werner.*

Vegetabile fossile bituminosum, *Wall.* t. ii. p. 415.—Bituminöses Holz, *Wid.* s. 631. *Id. Werner,* Pabst. b. i. s. 365.—Carbonated Wood, *Kirw.* vol. ii. p. 60.—Bituminöses Holz, *Estner,* b. iii. s. 166. *Id. Emm.* b. ii. s. 54.—Le Bois bitumineux commun ou parfait, *Broch.* t. ii. p. 44.—Bituminöses Holz, *Reuss,* b. iii. s. 146.—Holzige Braunkohle, *Lud.* b. i. s. 186. *Id. Suck.* 2ter th. s. 60.—Bituminöses Holz, *Bert.* s. 351. *Id. Mohs,*

Mohs, b. ii. s. 311.—Lignite fibreux, *Brong*. t. ii. p. 32.—Bituminöses Holz, *Leonhard*, Tabel. s. 48.—Holzige Afterkohle, *Haus*. s. 116.—Fasrige Braunkohle, *Karsten*, Tabel. s. 59.—Bituminöses Holz, *Lenz*, b. ii. s. 1057.—Holzförmige Braunkohle, *Haus*. Handb. b. i. s. 80.—Bituminöses Holz, *Hoff*. b. iii. s. 278.

External Characters.

Its colours are pale and dark blackish brown, and wood brown, which sometimes approaches to reddish-brown.

Its external shape resembles exactly that of stems and branches of trees, but is usually compressed.

Its principal fracture is glimmering, sometimes approaching to glistening: the cross fracture is shining. The first is lighter coloured than the second.

The fracture is fibrous in the small, slaty in the great, and corresponds with the woody texture: the cross fracture in some varieties is splintery.

The fragments are splintery, or cuneiform, but seldom indeterminately angular.

It is opaque.

The streak is shining.

It is soft, passing into very soft.

It is sectile.

It is slightly elastic-flexible.

It is rather easily frangible.

Specific gravity 1.0, 1.383, *Wiedeman*.

Chemical Characters.

It burns with a clear flame, and evolves, during combustion, a peculiar bituminous smell, which is very different from that of black coal.

Constituent

Constituent Parts.

According to Vauquelin, the bituminous wood of Rollo contains the following ingredients:

Vegetable Earth, -	54.0
Sulphate of Iron, -	10.7
Sulphur, - -	0.8
Oxide of Iron, -	12.7
Sulphate of Lime, -	0.7
Silica, - -	0.2
Loss, - -	

Geognostic Situation.

It usually occurs in alluvial land, in beds of common brown coal; sometimes also forming whole beds, part of which is converted into common brown coal and earth-coal. It sometimes also occurs in fragments, branches, &c. in clay; and in the Prussian amber-mines it is found in considerable quantity, and occasionally with adhering amber. Rocks of the secondary trap formation sometimes contain beds or imbedded portions of this mineral; and it is also met with in imbedded masses in secondary limestone and sandstone.

Geographic Situation.

In England, at Bovey Tracey, near Exeter; at the mouth of the Ouse, in Sussex: in Scotland, in the secondary trap formation, accompanied with pitch-coal, in the island of Skye; in separate pieces in trap-tuff, in the island of Canna; in limestone in the island of Skye; and in the coal formation in the counties of Fife and Mid-Lothian. It occurs

curs in considerable beds in the trap-rocks of the island of Iceland. On the Continent of Europe, it is met with both in Upper and Lower Saxony; also in Bohemia, Silesia, Moravia, Bavaria, Austria, Stiria, Transylvania, Russia, Poland, and France.

Use.

It is employed as fuel where great heats are not required.

Observations.

1. In Iceland, where it occurs in great quantity, it is called *Suturbrand.*

2. It passes into Common Brown Coal, with which it is often confounded.

Second Subspecies.

Earth-Coal, or Earthy Brown Coal.

Erdkohle, *Werner.*

Le Bois bitumineux terreux, *Broch.* t. ii. p. 45.—Erdkohle, *Reuss,* b. ii. 3. s. 159.—Lignite terreux, *Brong.* t. ii. p. 33.—Erdige Braunkohle, *Leonhard,* Tabel. s. 49.—Erdige Afterkohle, *Haus.* s. 116.—Erdige Braunkohle, *Karsten,* Tabel. s. 58.—Erdige bituminöses Holz, *Lenz,* b. ii. s. 1059.—Erdige Braunkohle, *Haus.* Handb. b. i. s. 80.—Erdkohle, *Hoff.* b. iii. s. 282.

External Characters.

It passes from blackish-brown, through wood-brown, into yellowish-grey. Sometimes it inclines to pitch-black.

It occurs massive. Its consistence is between cohering and loose, but more inclined to the latter.

Its particles are coarse, dusty, and soil a little.
Internally it is faintly glimmering, passing into dull.
The fracture in the more cohering masses is fine earthy.
The streak is somewhat shining.
Specific gravity 1.2.

Chemical Characters.

It burns easily, and diffuses, during combustion, a smell like that of burning bituminous wood. Alkohol dissolves a brownish-coloured bitter substance, having many of the properties of vegetable extract. By distillation it affords a honey-coloured oil, which is soluble in alkohol, and appears to be intermediate between resin and volatile oil. When this oil is freed of its watery parts, by exposure to a gentle heat, and then allowed to cool, it acquires the consistence of white cerate *.

Constituent Parts.

Earth Coal of Schraplau.

Carbonated Hydrogen,	59.0	cubic inches.
Carbonic Acid, -	8.5	
Acid Water, -	12.0	
Empyreumatic Oil, -	30.0	
Coal, - -	20.25	
Lime, - -	2.0	
Sulphate of Lime, -	2.5	
Clay, - -	0.5	
Oxide of Iron, -	1.0	
Sand, - -	11.5	

Klaproth, Beit. b. iii. s. 320.—323.

Geognostic

* This oil, according to Klaproth, resembles very much in its properties the substance called Sea or Lake Wax, which is found at Bargusin, on the shores of the Lake Baikal.

Geognostic and Geographic Situations.

It is found, along with bituminous wood, in Thuringia, in the district of Mansfeldt; and in the circles of Saal and Leipsic, it occurs in beds from twenty to forty feet thick, having an extent of several square miles.

Uses.

It is used as fuel where no great degree of heat is required, as in heating rooms, salt, nitre, and alum works, and in distillation. But to render it fit for these purposes, it must be moistened with water, beat in troughs, then made into bricks, and dried. Sometimes it is intermixed with small black coal, to increase the intensity of the heat. Its ashes are used with advantage as a manure; and a colour resembling umber prepared from it. It is also used as a *bistre* colour.

Observations.

1. It passes into Bituminous Wood, from which it differs principally in its state of aggregation.

2. When much iron-pyrites is dispersed through it, alum is prepared from it, as is the case at Muhlbach, and Komothan in Bohemia.

3. Its name is derived from its state of aggregation.

Third Subspecies.

Alum Earth.

Alaunerde, *Werner.*

Terra aluminaris, *Wall.* t. ii. p. 32.—Alaunerde, *Wid.* s. 398.—*Id. Estner,* b. ii. s. 647. *Id. Emm.* b. ii. s. 299.—Aluminite bitumineux, *Lam.* t. ii. p. 116.—La terre alumineuse, *Broch.* t. i. p. 383.—Alaunerde, *Reuss,* b. ii. 3. s. 152. *Id. Lud.* b. i. s. 110. *Id. Suck.* 2ter th. s. 528. *Id. Bert.* s. 218. *Id. Mohs,* b. ii. s. 311. *Id. Leonhard,* Tabel. s. 48. *Id. Karsten,* Tabel. s. 58.—Erdige Afterkohle, *Haus.* s. 116.—Alaunerde, *Lenz,* b. ii. s. 1063.—Erdige Braunkohle, *Haus.* Handb. b. i. s. 80.—Alaunerde, *Hoff.* b. iii. s. 285.

External Characters.

Its colours are blackish-brown, and brownish-black.

It is massive.

It is dull, sometimes glimmering; but this is owing to an intermixture of mica.

The fracture in the great, is thick or thin slaty, in the small, earthy.

It breaks into tabular pieces.

The streak is shining.

It feels rather meagre, and sometimes greasy.

It is sectile, and uncommonly easily frangible.

It is very soft, inclining to friable.

Chemical Characters.

When exposed to heat, it burns with a flame; and when

when left some time exposed to a moist atmosphere, it becomes warm, and at length takes fire.

Constituent Parts.

Charcoal, - -	19.65
Sulphur, - -	2.85
Silica, - -	40.00
Alumina, - -	16.00
Oxide of Iron, -	6.40
Sulphate of Iron, -	1.80
Sulphate of Lime, -	1.50
Magnesia, -	0.50
Sulphate of Potash, -	1.50
Muriate of Potash, -	0.50
Water, - -	10.75
	101.45

Klaproth, in Gehlen's Journ. vi. 44.

Geognostic Situation.

It occurs frequently in beds of great magnitude in alluvial land. It has been remarked, that where beds of brown coal have a covering of clay, that they afford good fuel; but when the cover is sand, the subjacent coal is alum earth.

Geographic Situation.

It is found in Bohemia, Saxony, Austria, Naples, Hungary, and in the Vivarais in France.

Uses.

It is first exposed to the air for several months, and then lixiviated,

lixiviated, to obtain the alum it contains: it is rarely used for fuel.

Fourth Subspecies.

Common Brown Coal, or Conchoidal Brown Coal.

Gemeine Braunkohle, *Werner*.

Braun Kohle, *Estner,* b. iii. s. 126.—La Houille brun, *Broch.* t. ii. p. 47.—Gemeine braun Kohle, *Reuss,* b. ii. 3. s. 154. *Id. Lud.* b. . s. 187. *Id. Suck.* 2ter th. s. 63. *Id. Bert.* s. 345. *Id. Mohs,* b. ii. s. 311. *Id. Leonhard,* Tabel. s. 48. *Id. Karsten,* Tabel. s. 58. *Id. Haus.* s. 117.—Muschliche Braunkohle, *Lenz,* b. ii. s. 1060.—Gemeiner Braunkohle, *Haus.* Handb. b. i. s. 78. *Id. Hoff.* b. iii. s. 287.

External Characters.

Its colour varies from blackish-brown to brownish-black.

It occurs massive, and sometimes ligniform.

Internally it is shining, and sometimes glistening; and the lustre is resinous.

The fracture is rather imperfect large conchoidal; and sometimes shews the fibrous woody texture.

The fragments are indeterminate angular, and more or less sharp-edged.

The colour is lighter in the streak.

It is soft and very soft.

It is rather brittle and easily frangible.

Specific gravity 1.2.

Chemical Characters.

It burns with a weak blue-coloured flame, and emits a smell like that of burning bituminous wood.

Constituent Parts.

200 Grains of the Bovey brown coal, by distillation, yielded,

	Grains.
1. Water, which soon came over acid, and afterwards turbid, by the mixture of some bitumen, - - - - -	60
2. Thick brown oily bitumen, - -	21
3. Charcoal, - - - - - -	90
4. Mixed gas, consisting of hydrogen, carbonated hydrogen, and carbonic acid,	29
	200

Hatchett, Phil. Trans. 1804.

Geognostic Situation.

It occurs in alluvial land, and in secondary or flœtz-trap rocks.

Geographic Situation.

It is found at Bovey near Exeter; in the Leitmeritzer, Saatzer, and Ellbogner circles in Bohemia; in the counties of Mansfeldt, Thuringia, Magdeburg, and the circles of Saal and Leipsic, in Lower Saxony; in Hessia, in the famous hill called the Meissner; at Kaltennordheim, in the district of Eisenach; at Stockhausen and Hoen in Westerward; Island of Bornholm in Denmark; in the Faroe Islands; Greenland.

Use.

It is used as fuel.

Observations.

Observations.

1. It is distinguished by its high degree of lustre, and conchoidal fracture.

2. We find in it, 1. Iron-pyrites: 2. Honeystone: 3. Amber: 4. A substance resembling Retinite.

3. It is to be observed passing into Bituminous Wood and Moor-Coal; sometimes also into Pitch-Coal.

Fifth Subspecies.

Moor-Coal, or Trapezoidal Brown-Coal.

Moorkohle, *Werner.*

Moorkohle, *Estner,* b. iii. s. 129.—La Houille limoneuse, *Broch.* t. ii. p. 48.—Moorkohle, *Reuss,* b. iii. s. 157. *Id. Lud.* b. i. s. 187.—Moorbraunkohle, *Suck.* 2ter th. s. 64.—Moorkohle, *Bert.* s. 346. *Id. Mohs,* b. ii. s. 313. *Id. Leonhard,* Tabel. s. 49.—Trapezoidische Braunkohle, *Karsten,* Tabel. s. 58. *Id. Haus.* s. 116.—Moorkohle, *Lenz,* b. ii. s. 1065.—Trapezoidische Braunkohle, *Haus.* Handb. b. i. s. 79.—Moorkohle, *Hoff.* b. iii. s. 289.

External Characters.

Its colour is dark blackish-brown, often passing into brownish-black.

It occurs massive, when first dug, but soon bursts and splits into rhomboidal pieces.

The lustre of the principal fracture is glimmering, of the cross fracture glistening, and the lustre is resinous.

The principal fracture is imperfect slaty; the cross fracture even, approaching to flat conchoidal.

The

The fragments are trapezoidal, approaching to cubical, seldom indeterminate angular.

It is soft and very soft.

It is sectile.

The streak is shining.

It is uncommonly easily frangible;—the most frangible species of coal.

Specific gravity.

Chemical Characters.

Nearly the same as those of brown coal.

Geognostic Situation.

It occurs in great beds in alluvial land, and in flœtz-trap rocks.

Geographic Situation.

It occurs in the Leitmeritzer, Saatzer and Ellbogner circles in Bohemia; at Thalern, near Krems in Austria; also in Transylvania, Moravia, the island of Bornholm in the Baltic Sea; the Faroe Islands; and with imbedded amber in Greenland. It occurs more frequently in Bohemia than in any other country.

Observations.

1. Its fracture and rhomboidal fragments distinguish it from other kinds of brown coal.

2. It is the most abundant kind of brown coal.

2. Black

2. Black Coal.

Schwartzkohle, *Werner.*

This species is divided into fonr subspecies, viz. Slate-Coal, Cannel-Coal, Foliated Coal, and Coarse Coal. * Soot-Coal.

First Subspecies.

Slate-Coal.

Schieferkohle, *Werner.*

Lithanthrax petrosus, *Wall.* Syst. Min. ii. 99. (in part).—Schieferkohle, *Estner,* b. iii. s. 147.—La Houille schisteuse, ou le Schieferkohle, *Broch.* t. ii. p. 52.—Schieferkohle, *Reuss,* b. iii. s. 132. *Id. Voigt,* s. 10. *Id. Lud.* b. i. s. 189.—Schiefer Steinkohle, *Suck.* 2ter th. s. 53.—Schieferkohle, *Bert.* s. 347. *Id. Mohs,* b. ii. s. 316. *Id. Leonhard,* Tabel. s. 49. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1068. *Id. Haus.* Handb. b. i. s. 74. *Id. Hoff.* b. iii. s. 296.

External Characters.

Its colour is intermediate between velvet-black and dark greyish-black. Sometimes it presents a pavonine or peacock-tail tarnish, sometimes a columbine tarnish.

It occurs massive *, and in ovoidal and columnar concretions.

It is shining or glistening, and the lustre is resinous.

The principal fracture is nearly straight, and generally thick

* According to Haüy, this coal may be split into right rhomboidal prisms of about 95°.—*Lucas,* t. ii. p. 259.

thick slaty; the cross fracture is imperfect and flat conchoidal, and sometimes even or uneven.

The fragments are sometimes slaty, sometimes trapezoidal, or indeterminate angular.

It is harder than gypsum, but not so hard as calcareous-spar.

The lustre is heightened in the streak.

It is brittle, inclining to sectile.

It is easily frangible.

Specific gravity—

According to *Kirwan*, 1.250 to 1.370 English.
1.259 From Irvine in Scotland.
Wiedeman, 1.277
Richter, 1.28125 to 1.3730 From Sabrze in Silesia.
1.32132 to 1.3820 Bielschowitz.
Breithaupt, 1.342 to 1.463 Postchaphel.

Chemical Characters.

It burns longer than cannel coal; cakes more or less, and after combustion leaves a slag.

Constituent Parts.

Slate-Coal of Waldenburg.	Slate-Coal of Sabrze.	Slate-Coal of Bielschowitz.	Slate-Coal of Whitehaven.
Bitumen, 36.875	Bitumen, 32.934	Bitumen, 37.890	Carbon, 56.8
Carbon, 57.993	Carbon, 63.312	Carbon, 58.172	Mixture of Asphalt and Maltha, in which the asphalt predominates, 43.0
Earth, 5.823	Earth, and Oxide of Iron, 3.904	Earths, and Oxide of Iron, 3.937	
Iron, and Oxide of Manganese, 1.157			
Richter, Neue Gegenst. d. Chem. vi. 234.	*Richter*, Neue Gegenst. d. Chem. vi. 224.	*Richter*, Neue Gegenst. d. Chem. vi. 224.	*Kirwan.*

Geognostic

Geognostic and Geographic Situations.

In England it is found in vast quantity at Newcastle, and in the great expanse of the coal formation in that neighbourhood; in the whole tract of the coal formation which stretches from Bolton, by Allonby, Workington to Whitehaven; in Scotland, in almost every quarter of the great river-district of the Forth; in great quantity in the river-district of the Clyde, at Cannoby, Sanquhar, and Kirkconnel, in Dumfriesshire: it is found also in Thuringia; electorate of Saxony; Bohemia; Silesia; Hungary; the Tyrol; Stiria; Bamberg; Bavaria; Salzburg; and France.

Observation.

It passes sometimes into Cannel and Foliated Coal.

Second Subspecies.

Cannel-Coal.

Kennelkohle, *Werner.*

Lithanthrax piceus, *Wall.* Syst. Min. ii. 99.—Cannelkohle, *Estner,* b. iii. s. 151.—La Houille de Kilkenny, ou le Kennelkohle, *Broch.* t. ii. p. 53.—Cannelkohle, *Reuss,* b. iii. s. 130. *Id. Voigt,* s. 172. *Id. Lud.* b. i. s. 189. *Id. Suck.* 2ter th. s. 53. *Id. Bert.* s. 348. *Id. Mohs,* b. ii. s. 320.—Houille compacte, *Brong.* t. ii. p. 3.—Kannelkohle, *Leonhard,* Tabel. s. 50. *Id. Karsten,* Tabel. s. 58.—Cannel Coal, *Kid,* vol. ii. p. 52.—Kennelkohle, *Lenz,* b. ii. s. 1071. *Id. Haus.* Handb. b. i. s. 75. *Id. Hoff.* b. iii. s. 303.—Candle Coal, *Aikin,* p. 61.

External

External Characters.

Its colour is intermediate between velvet and greyish-black.

It is massive.

Internally it is glistening, or glimmering, and the lustre is resinous.

The fracture is large and flat conchoidal, or even.

The fragments are irregular, cubical, or trapezoidal.

It is harder than gypsum, but not so hard as calcareous-spar.

It is brittle.

It is rather easily frangible.

Specific gravity,—

According to *Kirwan*,	1.232
Watson,	1.237
La Metherie,	1.270
Blumenbach,	1.275

Geognostic Situation.

It occurs along with the preceding subspecies in the coal formation.

Geographic Situation.

It is found in England near Whitehaven, Wigan in Lancashire, Brosely in Shropshire, Athercliff near Sheffield; in Scotland, at Gilmerton, in the neighbourhood of Edinburgh, and Muirkirk in Clydesdale.

Uses.

On account of its solidity, and the good polish it is capable of receiving when pure, it is cut into drinking-vessels

sels of various kinds, inkholders, snuff-boxes, &c.; but its principal use is as fuel.

Observations.

According to the Bishop of Llandaff, its name is derived from the word *candle*, because in some places the poor people use it in place of lights. In Scotland it is named *Parrot Coal.*

Third Subspecies.

Foliated Coal.

Blätterkohle, *Werner.*

Id. Estner, b. iii. s. 155.—Le Charbon lamelleux, *Broch.* t. ii. p. 54.—Blätterkohle, *Reuss,* b. iii. s. 128. *Id. Voigt,* s. 72. *Id. Lud.* b. i. s. 189. *Id. Suck.* 2ter th. s. 52. *Id. Bert.* s. 347. *Id. Mohs,* b. ii. s. 347. *Id. Leonhard,* Tabel. s. 50. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1069.—Glanzkohle, *Haus.* Handb. b. i. s. 73.—Blätterkohle, *Hoff.* b. iii. s. 303.

External Characters.

Its colour is velvet-black, and sometimes it has a pavonine or columbine tarnish.

It occurs massive, and in lamellar concretions.

The lustre is splendent and resinous.

The fracture is uneven.

The fragments are indeterminate angular, approaching to trapezoidal.

It is softer than cannel coal.

It is intermediate between brittle and sectile.

It

It is very easily frangible.

Specific gravity 1.344, 1.406, *Breithaupt*.

Constituent Parts.

	Whitehaven.
Carbon, - -	57.00
Bitumen, -	41.3
Ashes, -	1.7
	100 *Kirwan*.

Geognostic Situation.

It occurs in the coal formation, although not abundantly, and generally accompanied with slate-coal.

Geographic Situation.

It is found in the kingdom of Saxony, in Silesia, and in the coal-fields of this country.

Observations.

1. It is distinguished by its lamellar concretions, splendent lustre, and easy frangibility. It is nearly allied to Slate Coal, but in that subspecies the lustre is lower, and the lamellar concretions are wanting.

2. It frequently falls into pieces by the action of the weather, and sometimes even catch fire. These changes are caused by the decomposition of intermixed iron-pyrites.

Fourth

Fourth Subspecies.

Coarse Coal.

Grobkohle, *Werner.*

Id. Estner, b. iii. s. 158.—La Houille Grossiere, ou la Grobkohle, *Broch.* t. ii. p. 55.—Grobkohle, *Reuss,* b. iii. s. 123. *Id. Lud.* b. i. s. 190. *Id. Suck.* 2ter th. s. 51. *Id. Bert.* s. 346. *Id. Leonhard,* Tabel. s. 50. *Id. Lenz,* b. ii. s. 1073. *Id. Haus.* Handb. b. i. s. 76. *Id. Hoff.* b. iii. s. 306.

External Characters.

Its colour is dark greyish-black, inclining to brownish-black.

It occurs massive, and in granular concretions, which are intimately aggregated together.

It is glistening and resinous.

The principal fracture is imperfect, and thick scaly; the cross fracture is fine-grained uneven.

The fragments are sometimes indeterminate angular; sometimes rather blunt-edged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is rather brittle, and easily frangible.

Specific gravity 1.454, *Breithaupt.*

Geognostic Situation.

It is found in the coal formation.

Geographic Situation.

It occurs in coalworks in the neighbourhood of Dresden; also at Neustadt and Hohenstein in the Hartz; near

Sabrze

Sabrze in Upper Silesia; and in the district of Hameln in Hanover.

Observations.

This subspecies is characterised by its colour, and granular concretions.

Soot-Coal †.

Russ-Kohle, *Voigt.*

Russ-Kohle, *Karsten,* Tabel. s. 58.—Houille fuligineuse, *Haüy.*

External Characters.

Its colour is dark greyish-black.

It occurs massive.

It is dull or glimmering, and the lustre inclines to semi-metallic.

The fracture is uneven, sometimes inclining to earthy.

The fragments are blunt-edged.

It is shining in the streak.

It soils.

It is soft.

It is brittle, and easily frangible.

It is light.

Chemical Characters.

It burns with a bituminous smell, cakes, and leaves a small quantity of ashes.

Geognostic

† It is named *Clod Coal* in West Lothian?

Geognostic and Geographic Situations.

It occurs, along with slate-coal, in West Lothian, and other parts in the river-district of the Forth; and on the Continent, it is met with in Saxony and Silesia.

3. Glance Coal.

Harzlose Steinkohle, *Mohs.*

This species contains two subspecies, viz. Pitch Coal, and Glance Coal.

First Subspecies.

Pitch-Coal, or Jet.

Pechkohle, *Werner.*

Gemma Samothracea, *Plin.* Hist. Nat. xxxvii.?—Bitumen gagas, *Waller.* Syst. Min. t. ii. p. 106.—Pechkole, *Estner,* b. iii. s. 132.—La Houille piciforme, ou le Pechkole, *Broch.* t. ii. p. 49.—Pechkohle, *Reuss,* b. iii. s. 142. *Id. Lud.* b. i. s. 188. —Pechsteinkohle, *Suck.* 2ter th. s. 58.—Pechkohle, *Bert.* s. 349. *Id. Mohs,* b. ii. s. 317. *Id. Leonhard,* Tabel. s. 49. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1066. *Id. Haus.* Handb. b. i. s. 78. *Id. Hoff.* b. iii. s. 293.—Jet, *Aikin,* p. 62.

External Characters.

Its colour is velvet-black.

It occurs massive; and it is said also in plates, and sometimes in the shape of branches, with a regular woody internal structure.

Internally

Internally it is splendent, and the lustre is resinous.

The fracture is large and perfect conchoidal.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It is soft.

It affords a brown-coloured streak.

It is rather brittle.

It is easily frangible.

It does not soil.

Specific gravity, according to Wiedeman, 1.308.

Chemical Characters.

It burns with a greenish flame. Its chemical constitution is still imperfectly understood.

Geognostic Situation.

It occurs along with brown coal, in beds in flœtz trap and limestone rocks; also in beds and in imbedded portions in bituminous-shale.

Geographic Situation.

It occurs in secondary trap rocks in the Isle of Skye; in a similar situation in the Faroe Islands. On the Continent, it is met with in the Meissner hill in Hessia; at Irsenberg in Bavaria; in a bed of bituminous wood at Kunnerdorf in Bohemia; in a bed of loam above moor-coal, in the Saxon Erzgebirge; in bituminous-shale in limestone in Stiria.

Uses.

It is used as fuel, either in its natural state, or when converted into coaks. According to a report published in

 the

the "Journal des Mines," twelve hundred men are employed in the district of Aude in France, in fabricating, with the pitch-coal of that neighbourhood, rosaries, buttons, ear-rings, necklaces, bracelets, snuff-boxes, drinking-vessels, &c. One thousand hundred weight are yearly expended for this purpose; and, to Spain alone, the value of 18,000 livres is sold. In Prussia, the amber-diggers, who name it Black Amber, cut it into various ornamental articles.

Observations.

1. It is distinguished by its splendent resinous lustre, and perfect conchoidal fracture.

2. According to Voigt, it is to be observed passing on the one side into glance-coal, and on the other into brown coal.

3. Its name is derived from its pitchy aspect. It was formerly known by the name Gagat or Jet, a name derived from the river Gaga, or the city Gagas in Lesser Asia, where it was formerly dug.

4. It is named Black Amber by the Prussian amber-diggers, because it is found accompanying amber, and, when rubbed, becomes faintly electric.

5. Several varieties of slaggy mineral pitch, and cannel coal, are known by the name of Jet.

Second Subspecies.

Glance-Coal.

Glanzkohle, *Werner.*

This subspecies is subdivided into four kinds, viz. Conchoidal Glance-Coal, Slaty Glance-Coal, Columnar Glance-Coal, and Fibrous Coal.

First Kind.

Conchoidal Glance-Coal.

Muschliche Glanzkohle, *Werner.*

Anthracite compacte, *Haüy.*

Id. Estner, b. iii. s. 135.—La Houille eclatante, ou le Glanzkohle, *Broch.* t. ii. p. 50.—Glanzkohle, *Reuss*, b. iii. s. 138. *Id. Voigt*, s. 90. *Id. Leonhard*, Tabel. s. 49.—Schlagiger Anthracit, *Karsten*, Tabel. s. 58. *Id. Haus.* s. 115.—Muschlicher Anthracite, *Lenz*, b. ii. s. 1077.—Muschlicher Glanzkohle, *Hoff.* b. iii. s. 315.

External Characters.

Its colour is iron-black, of various degrees of intensity, which rather inclines to brown; and on the surface it has sometimes a tempered-steel coloured tarnish.

It occurs massive and vesicular; the interior of the vesicles has a tempered-steel coloured tarnish.

Internally it is splendent and shining, and the lustre is imperfect metallic.

The fracture is perfect and flat conchoidal, also small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is harder than gypsum, but not so hard as calcareous-spar.

It is rather brittle.

It is easily frangible.

Specific gravity 1.5, *Mohs.*

In thin pieces it emits a ringing sound.

Chemical Characters.

It burns without flame or smell, and leaves a white coloured ash.

Constituent

Constituent Parts.

Inflammable Matter,	-	96.66
Alumina,	- -	2.00
Silica and Iron,	-	1.33

Schraub. Beschr. d. Meissner, s. 146.

Geognostic Situation.

It occurs in beds in clay-slate, grey-wacke, Lydian-stone and alum-slate, through which latter it is often disseminated, and gives the glossy appearance to glossy alum-slate. It is much more abundant in secondary rocks, as in those of the coal and of the trap formations.

Geographic Situation.

It occurs in beds in the coal formation of Ayrshire, as near Cumnock and Kilmarnock; in the coal districts in the river-district of the Forth; and in Staffordshire in England. On the Continent, it is met with in the Meissner in Hessia, at Schönfeld in Saxony; and in the Alps of Switzerland.

Observations.

1. It appears to pass into Slaty Glance-coal, (coal-blende).

2. On the Meissner, it occurs along with other kinds of coal, in the following order, beginning with the uppermost: 1. Columnar coal: 2. Conchoidal glance-coal: 3. Pitch-coal: 4. Common brown-coal, passing into pitch-coal: 5. Brown-coal, with inclosed bituminous wood and earth-coal: 6. Bituminous wood.—*Voigt.*

Second Kind.

Slaty Glance-Coal.

Schriefege Glanzkohle, *Werner.*

Anthracite feuilleté, *Haüy.*

Plombagine charbonneuse, ou Anthracolite, *De Born,* t. ii. p. 296.—Kohlenblende, *Wid.* s. 653.—Native mineral Carbon, *Kirw.* vol. ii. p. 49.—Kohlenblende, *Estner,* b. iii. s. 197. *Id. Emm.* b. ii. s. 77.—Anthracite de Dolomieu, *Lam.* t. i. p. 76. —La Blende charbonneuse, ou la Kohlenblende, *Broch.* t. ii. p. 79.—Anthracite, *Haüy,* t. iii. p. 307.—Kohlenblende, *Reuss,* b. iii. s. 183.—Anthracite, *Brong.* t. ii. p. 55.—Kohlenblende, *Leonhard,* Tabel. s. 50.—Gemeiner Anthracit, *Karsten,* Tabel. s. 58. *Id. Haus.* s. 115.—Schiefriger Anthrazit, *Lenz,* b. ii. s. 1078. *Id. Haus.* Handb. b. iii. s. 317. *Id. Hoff.* b. iii. s. 317.

External Characters.

Its colour is dark iron-black, seldom inclining to brown; those varieties that border on graphite, incline to steel-grey.

It occurs massive.

Internally it is shining and glistening, and the lustre is imperfect metallic.

The principal fracture is more or less perfect slaty; the cross fracture small and imperfect conchoidal, or uneven.

The fragments are pretty sharp-edged, and sometimes trapezoidal.

It is rather softer than conchoidal glance-coal.

It is easily frangible.

It is intermediate between sectile and brittle.

Specific

Specific gravity 1.530, *Klaproth.* 1.415, *Thomson.* 1.300, *La Metherie.* 1.468, *Groess.* 1.526, *Kirwan.*

Chemical Characters.

According to Dolomieu, when reduced to powder, and heated in a crucible, it does not give any sulphureous or bituminous odour, and, on distillation, it affords neither sulphur nor bitumen. By exposure to a considerable heat, it burns without flame, and at length is consumed, leaving a greater or lesser portion of ash, according to its purity.

Constituent Parts.

	Panzenberg.	*Dolomieu.*
Carbon, -	90	72.05
Silica, -	4 to 2	13.19
Alumina,	4 to 5	3.29
Oxide of iron,	2 to 3	3.47
Loss,		8.00
	100	100.00

Geognostic Situation.

It occurs in imbedded masses, beds and veins, in primitive, transition, and secondary rocks. It occurs in Spain, in gneiss; in Switzerland and Savoy, in mica-slate and clay-slate; at Lischwitz, near Gera in Saxony, in transition rocks; in trap rocks, as in the Calton Hill at Edinburgh; in the coal formation in the river district of the Forth; and in a similar formation near the village of Brandau, in the Saatzer circle in Bohemia.

Geographic

Geographic Situation.

Europe.—It is found in several flœtz districts in Scotland, as near West Craigs in West Lothian, Dunfermline in Fifeshire, Cumnock, and Kilmarnock in Ayrshire, and in the island of Arran. In similar rocks in England, as in the southern parts of Brecknock, Caermarthenshire, Pembrokeshire, and Birch Hill, near Walsal in Staffordshire: also at Kilkenny in Ireland. On the Continent, it is met with at Kongsberg in Norway, where it is associated with native silver, in veins that traverse mica-slate: in the Hartz, in veins of red and brown iron-ore, which traverse grey-wacke; in imbedded masses in grey-wacke in Dauphiny; in mineral veins at Schemnitz in Hungary.

America.—Abundantly in the United States

Asia.—In the government of Katharinoslow in Siberia.

Observations.

In this country it is named *Blind Coal.*

Third Kind.

Columnar Glance-Coal.

Stangenkohle, *Voigt.*

Houille bacillaire, *Haüy.*

Stangenkohle, *Leonhard,* Tabel, s. 50. *Id. Karsten,* Tabel. s. 58. *Id. Lenz,* b. ii. s. 1067.—Stänglicher Anthrazit, *Haus.* Handb. b. i. s. 72.—Stangenkohle, *Hoff.* b. iii. s. 295.

External

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* Vid. Maclure's interesting Sketch of the Mineralogy of the United States, Dr Bruce's Mineralogical Journal, and particularly that valuable work, Cleaveland's Elementary Treatise on Mineralogy and Geology.

External Characters.

Its colours are velvet-black and greyish-black. It occasionally exhibits a tempered-steel tarnish.

It occurs massive, disseminated; also in prismatic concretions, which are sometimes straight, sometimes curved; and vary in thickness from a few lines to upwards of an inch, and from an inch to four or five inches in length.

The lustre is shining and glistening, and imperfect metallic.

The fracture is more or less perfect, and small conchoidal.

The fragments are indeterminate angular, and sharp-edged.

It is opaque.

It agrees in hardness with the other kinds.

It is brittle, and easily frangible.

Specific gravity 1.403, *Breithaupt.*

Chemical Characters.

It burns without flame or smoke.

Geognostic and Geographic Situations.

It forms a bed several feet thick, in the coal-field of Sanquhar in Dumfriesshire; at Saltcoats in Ayrshire, it occurs, not only in beds, along with greenstone, slate-clay, clay ironstone, and bituminous-shale, in the coal formation of that district, but also imbedded in the greenstone; about four miles from new Cumnock, also in Ayrshire, there is a bed of columnar glance-coal, from three to six feet thick, in which the columns are arranged in rows like basalt, and which

which is intermixed with compact, scaly, and columnar graphite. Both the graphite and columnar glance-coal are contained in the coal formation, and in some places contemporaneous masses of greenstone are imbedded in the coal. It occurs also at the Meissner in Hessia, where it is associated with conchoidal glance-coal, pitch-coal, brown-coal, bituminous wood, and earth-coal, and covered with greenstone and basalt.

Fourth Kind.

Fibrous Coal, or Mineral Charcoal.

Mineralische Holzkohle, *Werner.*

Mineralische Holzkohle, *Leonhard,* Tabel. s. 50.—Fasriger Anthracit, *Karsten,* Tabel. s. 58. *Id. Haus.* s. 115. *Id. Lenz,* b. ii. s. 1082.—Fasriger Anthrazit, *Haus.* Handb. b. i. s. 72. —Mineralische Holzkohle, *Hoff.* b. iii. s. 319.

External Characters.

Its colour is dark greyish-black, which sometimes approaches to velvet-black.*

It occurs massive, in thin layers, and single pieces; also in fibrous distinct concretions.

It is glimmering, bordering on glistening, and the lustre is silky or pearly.

The fragments are indeterminate angular, blunt-edged, sometimes also splintery.

It soils strongly.

It

* Jameson's Mineralogical Description of Dumfriesshire, p. 160, 161, 162.

It is soft, passing into friable.

It is very easily frangible.

Chemical Characters.

When exposed to a strong heat, it burns without flame or smoke; some varieties scarcely yield to the most intense heat.

Geognostic and Geographic Situations.

It occurs imbedded, or in thin layers, in black coal, sometimes inclosed in pitchstone, and it is said also occasionally associated with some varieties of brown coal. It is met with in the different coal-fields of Great Britain, and also in similar situations on the continent of Europe.

Observations.

1. Its fibrous concretions and silky lustre distinguish it from all the other kinds of coal.

2. It is not certain that this mineral is wood mineralised. Several of the varieties may be original carbonaceous matter, crystallised in fibrous concretions.

APPENDIX.

APPENDIX.

MINERALS whose Characters and place in the SYSTEM have not been determined.

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EARTHY AND SALINE MINERALS.

1. Allophane.

Allophan, *Stromeyer.*

External Characters.

Its principal colour is blue, but it also occurs green and brown.

It occurs massive, disseminated, small reniform, and botryoidal.

Externally and internally it is shining or glistening, and the lustre is vitreous.

The fracture is small and imperfect conchoidal.

The fragments are sharp-edged.

It is transparent, but only translucent on the edges in the brown varieties.

It is semi-hard.

It is brittle, and uncommonly easily frangible.

Specific gravity 1.852 to 1.889, *Stromeyer.*

Chemical Characters.

It readily gelatinates in acids.

Constituent Parts.

Water, -	41.301
Silica, -	21.922
Alumina, -	32.202
Lime, - -	0.730
Sulphate of Lime,	0.517
Carbonate of Copper,	3.058
Hydrate of Iron,	0.270
	100 *Stromeyer.*

 Geognostic

Geognostic and Geographic Situations.

It occurs in a bed of ironshot limestone in grey-wacke-slate in the Forest of Thuringia.

Observations.

1. It is characterized by its uncommonly easy frangibility, and low specific gravity: it is distinguished from *Hyalite* and *Opal* by colour, inferior hardness, and low specific gravity.

2. It has been described under the name Riemannite, in honour of M. Riemann, who first noticed it. Its present name was given to it by Stromeyer.

2. Amblygonite.

Amblygonit, *Breithaupt.*

External Characters.

Its colours are greenish-white, pale mountain-green, and celandine-green, and marked externally with reddish and yellowish-brown spots.

It occurs massive; and crystallized in oblique four-sided prisms.

Internally it is shining and vitreous.

Its cleavage is said to be parallel with the sides of an oblique four-sided prism of 106° 10′ and 73° 50′.

The fracture is uneven.

The fragments are oblique rhomboidal.

It ranges from translucent to translucent on the edges.

It is as hard as felspar.

It is brittle, and easily frangible.

Specific gravity 3.00, 3.04, *Breithaupt.*

Chemical Characters.

It melts easily before the blowpipe into a white enamel. During fusion, it emits a reddish-yellow phosphoreal light, and intumesces, and loses a considerable quantity of some volatile ingredient.

Geognostic and Geographic Situations.

It occurs in granite, along with green topaz and tourmaline, near Penig in Saxony.

Observations.

1. It is distinguished from *Felspar* by its cleavage, and greater specific gravity; and from *Prismatic Spodumene* by its cleavage.

2. It appears to be a species of the genus Spodumene.

3. The name is from the Greek word ἀμβλυγωνιος, which refers to its blunt-edged prismatic form.

3. Aplome, *Haüy*.

This mineral has a deep brown or orange-yellow colour. Occurs crystallized in rhomboidal dodecahedrons, which are so streaked as to point out the cube as its primitive form. In lustre, fracture, and hardness, it agrees with common garnet, but its specific gravity is lower, not exceeding 3.444. It is found on the banks of the river Lena in Siberia.

4. Basalt-Jasper.

Basalt-Jaspis, *Friesleben.*

External Characters.

Its principal colour is lavender-blue; but it also occurs pearl, bluish, greenish, and yellowish grey, and from the latter it passes into yellowish and liver brown. Sometimes these colours are arranged in stripes.

It occurs massive, and coarsely disseminated.

Internally it ranges from glistening to glimmering, and the lustre is resinous, inclining slightly to vitreous.

The fracture is small and imperfect conchoidal, and sometimes coarse-grained uneven.

The fragments are rather sharp-edged.

It is opaque.

It is hard in a middling degree.

Specific gravity 2.41. The specific gravity is probably higher.

Geognostic and Geographic Situations.

It occurs imbedded in basalt in many districts in Germany.

Observations.

1. This substance has been described under a variety of names: thus Dr Zimmermann names it *Systyl;* other authors *Basaltic Hornstone;* and Dr Reuss describes it as a variety of *Porcelain Jasper.* It is conjectured to be nearly allied to Azurestone.

2. Gmelin

2. Gmelin describes a blue mineral found on Vesuvius, which bears some resemblance to basalt-jasper *.

5. Fibrolite.

Id. Bournon, Ph. Trans. 1802, p. 289. *Id. Haüy. Id. Delam. Id. Karsten. Id. Lucas.*

External Characters.

Its colours are white and grey.

It occurs crystallized in rhomboidal prisms, the angles of whose planes are 80° and 100°.

Internally it is glistening.

The principal fracture is fibrous, the cross fracture is uneven.

It is harder than quartz.

Specific gravity 3.214.

Constituent Parts.

Alumina, - -	58.25
Silica, - -	38.00
Iron, and loss,	3.75
	100

Chenevix, Phil. Trans. 1802, p. 335.

Geographic Situation.

It is found in the Carnatic.

Observations.

It was first described and named by Bournon.

* Schweigger's Journ. f. Chemie und Physik, b. xiv, Heft 3.

6. Gehlenite.

External Characters.

This mineral is described as a subspecies of Vesuvian at pages 138. and 139. of Vol. I. It would have been better to have marked it off with an asterisk, and placed it beside Vesuvian, as a substance nearly allied to it, and not as belonging to the same species, because its hardness and specific gravity are inferior to that of Vesuvian. The following analysis of it has been lately published:

Constituent Parts.

Lime, - -	35.50
Silica, - -	29.64
Alumina, - -	24.80
Oxide of Iron, -	6.56
Volatile ingredients,	3.30
	99.60

Fuchs, in Schweig. Journ. Bd. xv. h. 4. s. 377.

7. Holmite, *Clarke.*

External Characters.

It occurs crystallized in the form of an oblique four-sided prism, and possesses a specific gravity of 3.597.

Constituent

Constituent Parts.

Lime, - - -	27
Carbonic Acid, -	21
Alumina, - -	6½
Silica, - - -	6½
Oxide of Iron, -	29
Water, - -	10

Holme.

Observations.

It was named in honour of Mr Holme, who analysed it. Its geognostic situation is unknown.

8. Humite.

Humite, *Bournon.*

Id. Bournon, Cat. Min. p. 52.

External Characters.

Its colour is reddish-brown.

It occurs crystallised in octahedrons, which are always more or less truncated and bevelled.

The planes are frequently transversely streaked.

Its lustre is shining.

It is transparent.

It scratches quartz with difficulty.

Geognostic and Geographic Situations.

It occurs at Somma, near Naples, in a rock composed of grey-coloured granular topaz, mixed with grains of pale yellow

yellow and green topaz, which latter is sometimes crystallised in cavities; also with brown and olive-green mica, and white haüyne.

Observations.

The preceding account is from Bournon's *Catalogue Mineralogique*, and it contains all that is known of the species. It was named by Bournon in honour of Sir Abraham Hume, Baronet, a zealous cultivator of mineralogy, and possessor of one of the most valuable and splendid mineralogical cabinets in England.

9. Konite or Conite.

Konit, *Friesleben.*

External Characters.

Its colours are ash, yellowish, and greenish grey; but on exposure to the air becomes brown.

It occurs massive, also stalactitic, with pyramidal impressions of quartz, and in crusts.

Internally it is dull.

The fracture is small-grained uneven, also fine splintery, and occasionally flat conchoidal.

The fragments are rather sharp-edged.

It is translucent on the edges, or opaque.

It is semi-hard.

It is brittle, and rather easily frangible.

Specific gravity 2.83—2.899.

Chemical Characters.

It becomes black before the blowpipe, but does not melt. It dissolves with feeble effervescence in nitrous acid.

Constituent

Constituent Parts.

Carbonate of Magnesia,	67.5
Carbonate of Lime, -	28.0
Oxide of Iron, - -	3.5
Water, - - - -	1.0
	100.0

Geognostic and Geographic Situations.

It occurs in the trap hill named Meissner in Hessia. It is said also to have been found in Saxony and Iceland.

10. Lievrite.

Lievrit, *Werner.*

Yenite, *Lelievre,* Journal des Mines, N. 121. p. 65. *Id. Haüy,* Tabl. p. 42. & 182.—Ilvait, *Steffens,* b. i. s. 356,—Lievrit, *Hoff.* b. ii. s. 376—Yenit, *Lenz,* b. i. s. 215.

External Characters.

Its colour is intermediate between dark greyish-black and iron-black, but sometimes passes through raven-black into blackish-green.

It occurs massive; also in distinct concretions, which are small and scopiform radiated, and in others which are thin and straight prismatic; and crystallized in the following figures:

1. Oblique four-sided prism, acuminated on the extremities with four planes, which are set on the lateral planes *.

2. Four-

* Yenit quadrioctonal, Haüy.

2. Four-sided prism, which is almost rectangular, bevelled on the extremities, and the bevelling planes set on the obtuse edges.
3. The preceding figure, in which the angles of the bevelment are bevelled.
4. The preceding figure, in which the angles of the second bevelment are truncated, and the obtuse lateral edges of the prism bevelled.

The crystals vary from acicular to the thickness of half an inch: they are frequently scopiformly aggregated, sometimes superimposed, and sometimes imbedded.

The lateral planes of the crystals are longitudinally streaked.

The lustre of the fracture is glistening and semi-metallic.

The fracture is uneven.

The fragments are indeterminate angular, rather sharp-edged.

It is opaque.

It is hard in a low degree: it scratches glass with ease, and gives a few sparks with steel, but is scratched by adularia.

It does not change its colour in the streak.

is easily frangible.

Specific gravity 3.825, 4.061, *Lelievre.*

Chemical Characters.

It is attacked by the three mineral acids, but does not gelatinate with them. When exposed to heat, it becomes magnetic; its colour is changed from black into dark reddish-brown, and it loses about 2 *per cent.* of weight. Before the blowpipe, it melts easily, and without intumescence, into an opaque black bead, which has a dull metallic as-

pect,

pect, and is attracted by the magnet, but does not possess polarity. It dissolves in glass of borax, with a slight ebullition.

Constituent Parts.

Silica, 28.0	Silica, - 29	Silica, 30.0	Silica, 30.0
Alumina, 0.6	Lime, - 12	Lime, 12.5	Alumina, 1.0
Lime, 12.0	Oxide of Iron and Oxide of Manganese, 57	Oxide of Iron and Oxide of Manganese, 57.5	Lime, 14.8
Oxide of Iron, 55.0			Oxide of Iron, 49.0
Oxide of Manganese, 3.0			Oxide of Manganese, 2.0
98.6	98	100.0	96.8
Descotils.	*Vauquelin.*	*Vauquelin.*	*Vauquelin.*

Geognostic and Geographic Situations.

It occurs in primitive limestone, along with epidote, quartz, garnet, magnetic ironstone, and crystallized arsenic-pyrites, at Rio la Marine, and Cape Calamite, in the island of Elba. It is said also to occur in Siberia.

Observations.

1. Colour, crystallization, kind of lustre, fracture, distinct concretions, opacity, hardness, and considerable weight, distinguish this mineral from all others with which it might be confounded.

2. Werner places it in the system between Schorl and Epidote: in the systems of Haüy, Steffens, and Lenz, it follows Augite. The quantity of iron it contains is remarkable; and if not accidental, shews that Lievrite probably belongs to a family different from any in the Wernerian system.

11. Omphacite.

11. Omphacite.

Omphazit, *Werner*.

External Characters.

Its colour is intermediate between pale leek and mountain green, and sometimes inclining to grass-green.

It occurs massive and disseminated; also in narrow and short radiated and granular distinct concretions.

Internally it ranges from glistening to glimmering, and the lustre is resinous.

Cleavage same as that of common augite.

The fracture is fine grained uneven.

It is feebly translucent.

It is as hard as felspar.

Specific gravity = 3.30.

Geognostic and Geographic Situations.

It occurs in primitive rocks with precious garnet, sometimes also with kyanite, mica, and actynolite, in the Sau-Alpe, in Carinthia; and near Hoff in Baireuth.

Observations.

1. It is considered by Werner as a distinct species; but the circumstance of its agreeing with Augite in cleavage, hardness, and specific gravity, prove that it is a mere variety of that species.

2. The name Omphacite is from *Omphax*, the name given by Pliny to a green-coloured mineral, and which Werner has adopted for this variety of augite.

12. Pharmacolite,

12. Pharmacolite, or Arsenic-Bloom.

Arsenikblüthe, *Werner.*

Pharmakolith, *Karsten,* Tabel. (1. Ausg.) 36. 75.—Chaux arseniaté, *Haüy,* t. ii. p. 293.—Pharmakolith, Nordeutsche Beit. z. Berg. und Huttenk. iii. s. 116. *Id. Karsten,* Tabel. (2. Ausg.) s. 74. *Id. Haus.* Handb. b. iii. s. 860. *Id. Aikin,* p. 65.

External Characters.

Its colours are reddish-white, snow-white, yellowish-white, and milk-white.

It occurs as a coating, in small balls, small reniform, and botryoidal, with a drusy surface; frequently in very delicate capillary shining crystals, which are scopiformly or stellularly aggregated.

Externally it is glimmering, and the lustre is silky.

Internally it is shining or glistening, and silky on the radiated, but dull on the earthy fracture.

The fracture is very delicate, straight, scopiform and stellular radiated, and sometimes passes into fibrous, also earthy.

The fragments are indeterminate angular, and also wedge-shaped.

It occurs in coarse and small granular distinct concretions.

It alternates from semi-transparent to opaque, which latter occurs in the varieties with earthy fracture.

It is very soft, passing into friable.

It is easily frangible.

It soils.

Specific gravity, 2.536, *Selb.* 2.640, *Klaproth.*

Chemical

Chemical Characters.

Before the blowpipe it is almost entirely dissipated, with a dense white arsenical vapour.

Constituent Parts.

	Wittichen.	Andreasberg.
Lime, -	25.00	27.28
Arsenic Acid,	50.44	46.58
Water, -	24.56	23.86
	100	96.82
	Klaproth, Beit. b. iii. s. 281.	*John*, in Gehlen's Journ. f. Chem. und Phys. b. iii. s. 539.

Geognostic Situation.

It occurs in veins along with tin-white cobalt, native arsenic, and frequently earthy red cobalt-ochre.

Geographic Situation.

It is found in veins in granite in the mine named Sophia near Wittichen in Fürstenberg; at Andreasberg in the Hartz; Riegelsdorf; and Glucksbrunn in the Forest of Thuringia.

13. Pimelite, *Karsten.*

This mineral Werner considers to be a variety of Steatite. It occurs at Kosemutz in Silesia.

14. Rhætizite.

14. Rhætizite.

Rhætizit, *Werner.*

External Characters.

Its colours are greyish, milk, and yellowish white, from which latter it passes into pale ochre and isabella yellow, and into brick-red; and on the other side into greyish-white, bluish and smoke grey.

It occurs massive; and in scopiform and promiscuous radiated distinct concretions, which are collected into others which are large and longish angulo-granular.

It is glistening, shining and pearly.

The fragments are wedge-shaped and splintery.

It is feebly translucent on the edges.

In other characters same as kyanite.

Geognostic and Geographic Situations.

It occurs in primitive rocks, associated with quartz, mica, and graphite, at Pfitzsch in the Tyrol.

Observations.

1. It is named from Rhætia, its only known locality.
2. It is a variety of Kyanite.

15. Sphærulite.

Sphærulit, *Breithaupt.*

External Characters.

Its principal colours are brown and grey.

It

It occurs in imbedded roundish balls and grains, which are sometimes reniformly aggregated; also in stellular fibrous concretions.

Externally it is sometimes smooth, (when it has a milky incrustation), sometimes rough.

Internally it alternates from glimmering to dull.

The fracture is even and splintery.

It is opaque, or translucent on the edges.

It scratches quartz with difficulty.

It is brittle, and easily frangible.

Specific gravity 2.52,—2.40.

Chemical Characters.

It is nearly infusible before the blowpipe.

Geognostic and Geographic Situations.

It occurs in pearlstone and pitchstone-porphyries, where it is often associated with small scales of mica, and portions of felspar.

It occurs imbedded in pearlstone in the vicinity of Glasshütte near Schemnitz; in the pitchstone of Meissen; and the hornstone balls found at Planitz are probably varieties of this mineral. It is also found in Iceland, imbedded in pitchstone.

Observations.

1. It is distinguished by its colour, form, and high degree of hardness. It is distinguished from *Obsidian* by colour, inferior lustre, and fracture; from *Pearlstone*, by greater hardness and specific gravity.

2. It is named *Sphærulite* from its form.

16. Spak.

16. Spak, *Breithaupt.*

External Characters.

Its colours are yellowish and greyish white.

It occurs in small veins, and in thin prismatic distinct concretions.

Internally it is shining and resinous.

It has a threefold rectangular cleavage.

Its fracture is small grained uneven, also small splintery.

It is translucent.

It is soft, inclining to very soft.

It is brittle, and easily frangible.

It has a feeble sweetish saline taste.

Chemical Characters.

It is completely soluble in water.

Geognostic and Geographic Situations.

It occurs in the salt-mines of Wieliczka and Bochnia in Poland.

Observations.

1. Its taste is very different from that of common salt, and therefore cannot like that mineral be used with food.

2. It is said to be the Fibrous Rock-salt of Werner.

17. Skorodite.

Skorodit, *Breithaupt.*

External Characters.

Its colour is leek-green, which passes on the one side into

into celandine-green and blackish-green, on the other into liver-brown.

It occurs massive, and disseminated, but most frequently crystallised, in very short broad rectangular four-sided prisms, acutely acuminated on both extremities, with four planes, which are set on the lateral edges.

The narrow lateral planes are longitudinally streaked; the others are smooth, and ranging from shining to splendent, and the lustre is intermediate between vitreous and pearly.

There is one distinct cleavage parallel with the broader lateral planes of the prism, consequently in the direction of the shorter diagonal of an oblique four-sided prism.

The fracture is intermediate between uneven and small and imperfect conchoidal.

It is translucent on the edges, or semitransparent.

It is as hard as calcareous-spar.

It is easily frangible.

Chemical Characters.

It easily melts before the blowpipe, with the copious emission of arsenical vapour, and is converted into a reddish-brown mass, which, when highly heated, so as to drive off all the arsenic, becomes attractable by the magnet. These phenomena shew that this mineral is an arseniate of iron, probably combined with manganese. It contains no copper.

Geognostic and Geographic Situation.

It occurs imbedded in a bed composed of quartz and hornstone, in primitive rocks in the Schneeberg mining district in Saxony; also at Löling in Carinthia.

18. Spinellane *.

External Characters.

Its colour is plum-blue.

It occurs crystallised, in rhomboids of 117° 23′; and 62° 37′; and in six-sided prisms acuminated with three planes.

It scratches glass.

Geognostic and Geographic Situations.

It occurs on the shores of the Lake of Laach, in a rock composed of grains and small crystals of glassy felspar, quartz, hornblende, black mica, and magnetic iron-ore, in small grains.

Observation.

It is said to be a variety of Haüyne.

19. Steinheilite.

This beautiful mineral has been ascertained to belong to the species Prismato-rhomboidal Iolite.

20. Stilpnosiderite †, *Ulmann.*

External Characters.

Its colour ranges from brownish-black to blackish-brown.

It occurs massive, small reniform, irregular dendritic, and in curved lamellar concretions.

 Internally

* So named from its resemblance to Spinel.

† So named on account of its characteristic high lustre, and its ferruginous contents, from the Greek words στιλπνος, *shining*, and σιδηρος, *iron*.

Internally it is splendent and shining, and the lustre resinous.

The fracture nearly perfect conchoidal.

The fragments are sharp-edged.

It is opaque.

It affords a yellowish-brown streak.

It is hard in a low degree.

It is brittle, and easily frangible.

Specific gravity 3.77, *Breithaupt.*

Chemical Characters.

Is infusible without addition before the blowpipe; melted with borax, it forms a dark olive-green glass.

Constituent Parts.

Oxide of Iron, -	80.50
Silica, - -	2.25
Water, - -	16.00
Oxide of Manganese, a trace.	
	98.75 *Ullmann.*

It is said by other mineralogists to contain a considerable portion of phosphoric acid.

Geognostic and Geographic Situations.

It generally occurs along with brown iron, and is sometimes associated with green lead-spar. It is found in Saxony and Bavaria.

Observations.

1. It is very nearly allied to meadow iron-ore, and may prove to be a variety of that mineral.

2. It has been described under the names Slaggy or Vitreous Brown Iron-ore, Pitchy Iron-ore, and Glance Iron-ore.

* Chusite, Limbillite, Sideroclepte, Mellilite, and Succinite, minerals described by Saussure and Bonvoisin, appear to be varieties of Olivine and Augite.

METALLIFEROUS MINERALS.

21. Argentiferous Copper-Glance.

Silber Kupfer-glanz, *Hausmann.*

External Characters.

Its colour is blackish lead-grey.

It occurs massive and disseminated.

Internally it is shining or glistening, and the lustre is metallic.

The fracture is flat conchoidal, passing into even.

It becomes more shining in the streak, but the colour is not changed.

It is soft.

It is sectile, and rather difficultly frangible.

Specific gravity 6.255, *Stromeeyr.*

Constituent Parts.

Sulphuret of Copper,	38.654
Sulphuret of Silver,	60.646
Sulphuret of Iron,	0.700
	100 *Stromeyer.*

Geognostic and Geographic Situations.

This rare mineral is found only at Schlangenberg in Siberia, where it is associated with copper-pyrites, calcareous-spar, and hornstone.

Observations.

1. Colour, fracture, softness, and perfect sectility, are the principal characters of this mineral.

2. It is intermediate between copper-glance, brittle silver-glance, and common silver-glance.

22. Oxide of Arsenic.

Arsenikblüthe, *Karsten.*

Arsenic oxydé, *Haüy,* t. iv. p. 225.—Arsenikblüthe, *Reuss,* b. iv. s. 522. *Id. Karsten,* Tabel. s. 74.—Arsenic oxydé, *Haüy,* Tabl. p. 108. *Id. Lucas,* t. ii. p. 447.—Arseniblüthe, *Haus.* Handb. b. iii. s. 805.

It is divided into three subspecies, viz. Common, Capillary, and Earthy.

First Subspecies.

Common Oxide of Arsenic.

Gemeine Arsenikblüthe, *Hausmann.*

Id. Haus. Handb. b. iii. s. 805.

External Characters.

Its colours are snow-white or milk-white, and sometimes tinged accidentally reddish, yellowish, or greenish.

It occurs in crystalline or stalactitic crusts; sometimes in small, adhering, tabular or prismatic crystals.

Internally it is shining or glistening, and the lustre is intermediate

intermediate between vitreous and adamantine; sometimes pearly.

The fracture is uneven, more or less inclining to radiated, and foliated.

It alternates from opaque to semitransparent.

It is soft.

Second Subspecies.

Capillary Oxide of Arsenic.

Haarförmige Arsenikblüthe, *Hausmann.*

Id. Haus. Handb. b. iii. s. 806.

External Characters.

Its colour is snow-white.

It occurs in very delicate capillary crystals, which are sometimes scopiform, sometimes globularly aggregated; and are often so delicate, that the whole appears like the finest mould.

The lustre is silky and shining.

Third Subspecies.

Earthy Oxide of Arsenic.

Erdige Arsenikblüthe, *Hausmann.*

Id. Haus. Handb. b. iii. s. 806.

External Characters.

Its colour is yellowish and greyish-white.

It

It seldom occurs massive; more frequently in crusts, and stalactitic.

It is dull.

The fracture is fine earthy.

It is opaque.

It sometimes occurs in curved lamellar concretions.

It is friable.

Geognostic and Geographic Situation of the Species.

It occurs at Andreasberg in the Hartz, along with native arsenic, red silver, antimonial silver, galena or lead-glance, yellow orpiment, and corroded quartz; at Biber, along with sulphate of cobalt; at Joachimsthal with orpiment. It is also found at Gistain in the Pyrennees, and at Saint Marie aux Mines in France; and in the Island of Guadaloupe.

Observations.

It very much resembles Pharmacolith, with which, indeed, it has been often confounded. An obvious chemical character may be used for distinguishing them;—the oxide of arsenic is soluble in water, which is not the case with pharmacolith.

23. Bismuthic Silver.

Wissmuth Silbererz, *Selb.*

Wismuthisches Silber, *Selb,* in Crell's Chem. Annal. 1793, 1. 10. *Id. Wid.* s. 716.—Wismuthblei, *Reuss,* b. ii. 4. s. 191. *Id. Karsten,* Tabel. s. 68.—Wismuthsilbererz, *Selb,* in den Mineralogischen Studien, b. i. s. 79.—Bismuthic Silver, *Aikin,* p. 28.

External

External Characters.

Its colour is pale lead-grey, becoming deeper on exposure to the air.

It occurs disseminated; and rarely crystallised in acicular and capillary crystals.

Its lustre is glistening and metallic.

The fracture is fine-grained uneven.

It is soft.

It is sectile.

It is easily frangible.

Chemical Characters.

Before the blowpipe, metallic globules begin to ooze out, and on the addition of borax, unite into one mass, the flux at the same time acquiring an amber colour: the metallic button is brittle, and of a tin-white colour.

Constituent Parts.

Bismuth,	27.00
Lead,	33.00
Silver,	15.00*
Iron,	4.30
Copper,	0.90
Sulphur,	16.30
	96.50

Klaproth, Beit. b. ii. s. 297.

Geognostic and Geographic Situations.

It has hitherto been found only in the mine named Friedrich-Christian in the Schapbach, in the Black Forest, where

* Selb, in his Mineralogical Studies, vol. i. p. 81. states the quantity of silver in this ore at 20 *per cent.*

where it occurs in veins that traverse gneiss, along with copper-pyrites, and quartz, and a smaller quantity of iron-pyrites, and galena or lead-glance.

24. Blue Ironstone.

Blaueisenstein, *Klaproth.*

External Characters.

Its colour is indigo-blue, which inclines to lavender-blue.

It occurs massive, and with impressions of crystals of brown iron-ore.

Externally it is glimmering, internally dull.

The fracture is coarse-grained uneven.

It is opaque.

It is semihard.

It is rather brittle, and easily frangible.

Specific gravity 3.20, *Klaproth.*

Chemical Characters.

It loses its colour on exposure to heat; and when melted with borax, forms a clear green bead.

Constituent Parts.

Oxide of Iron,	-	40.5
Silica,	-	50.0
Lime,	-	1.5
Natron,	-	6.0
Water,	-	3.0
		100.0

Geographic

Geographic Situation.

It occurs on the Orange River in Southern Africa.

Uses.

It is used for painting houses at the Cape of Good Hope.

Observations.

1. Colour, hardness, and specific gravity are the principal characters of this mineral.

2. It was brought from the Cape of Good Hope by Professor Lichtenstein of Berlin.

25. Crichtonite.

Craitonite, *Bournon.*

Id. Bournon, Cat. Min. p. 430.

External Characters.

Its colour is velvet-black.

It occurs crystallised, in the following figures:

1. Very acute rhomboids, with angles of 18° and 162°; or it may be described as an acute double three-sided pyramid, in which the lateral planes of the one are set on the lateral edges of the other.
2. In which the summits of the pyramids are more or less deeply truncated.
3. The summits of the pyramids acuminated with three planes, which are set on the lateral planes, and the summits of the acumination truncated.
4. In which the angles of the summits of the pyramids are bevelled.

The

The crystals are very small.

Externally and internally it is splendent, and the lustre is vitreous, inclining to metallic.

The cleavage is indistinct.

The fracture is conchoidal.

It is opaque.

It is harder than octahedrite; it scratches fluor-spar, but it does not affect glass.

It does not affect the magnet.

Chemical Character.

It is infusible without addition before the blowpipe.

Geognostic Situation.

It occurs in primitive rocks along with octahedrite, in the different countries where that mineral is found.

Observations.

1. It was named Crichtonite by Bournon, in honour of an excellent mineralogist, my friend Dr Crichton, physician to the Emperor of Russia.

2. It appears to have been confounded, sometimes with octahedrite, sometimes with micaceous iron-ore; it is probably a new species of titanium-ore.

26. Cupreous Manganese.

Kupfer Manganerz, *Breithaupt.*

External Characters.

Its colour is bluish-black.

It occurs massive, small reniform, and botryoidal.

Externally and internally it is shining and resinous.

The

The fracture is perfect conchoidal.

The fragments are rather sharp-edged.

It is opaque.

It is not changed in the streak.

It is intermediate between hard and semihard.

It is rather brittle, and easily frangible.

Specific gravity 3.197,—3.216, *Breithaupt.*

Constituent Parts.

Black Oxide of Manganese,	82.0
Brown Oxide of Copper, -	13.5
Silica, -	2.0
	97.5

Lampadius.

Geognostic and Geographic Situation.

It occurs in primitive rocks at Schlackenwald in Bohemia.

Observations.

1. It is characterised by its colour, lustre, hardness, and specific gravity.

2. It is distinguished from black cobalt ochre by its hardness, lustre, and its specific gravity.

27. Native Nickel.

Haarkies, *Werner.*

Nickel Natif, *Haüy.*

External Characters.

Its colour is a kind of brass-yellow, which inclines to bronze-yellow, and seldomer to steel-grey.

It

It occurs in delicate capillary crystals.

It is shining or glistening, and the lustre is metallic.

The crystals are rigid.

It is brittle.

Constituent Parts.

It consists, according to Klaproth, of Nickel, with a small quantity of cobalt and arsenic.

Geognostic and Geographic Situations.

It occurs in veins in gneiss, where it is associated with hornstone, quartz, calcareous-spar, and brown-spar, at Johangeorgenstadt in Saxony; also in the cavities of copper nickel in Huel Chance Mine, near St Austle in Cornwall.

Observations.

This mineral cannot correctly be considered a native nickel, because it wants the characters of pure nickel; it is rather to be viewed as a compound of nickel with cobalt and arsenic.

2. It is the *Haarkies* of Werner.

28. Orthite.

This mineral is so named because it always occurs in straight layers, generally in felspar. It resembles Gadolinite. It is composed of protoxide of cerium 19.50; protoxide of iron 12.44; protoxide of manganese 3.44; yttria 3.44; silica 32.00: alumina 14.80; lime 7.84; water 5.36, *Berzelius.*

It is found in the mine of Finbo, in the vicinity of Fahlun

lun in Sweden. The mine is situated in a vein of granite which traverses gneiss.

A variety of orthite was discovered in another mine near Fahlun, and which possesses the property of taking fire before the blowpipe, and of continuing to burn for some moments. It is named *Pyrorthite*. Besides the same constituents, as Orthite, it contains 25 *per cent.* of carbon.

Several other combinations of cerium have been described under the names *Yttrocerite*, *Sub-fluate of Cerium*, *Deuto-fluate of Cerium*, and *Double Fluate of Cerium and Yttria*; but our knowledge of these is very imperfect and unsatisfactory.

29. Pyrosmalite.

Pyrodmalite, *V. Moll's* Eph. iv. s. 390.—*Hisinger*, Samling till en Mineralogisk Geograffi öfver Swerige, 175.—Pyrosmalith, *Karsten*, Tabel. s. 103. *Id. Haus.* Handb. s. 1068.—Fer muriaté, *Haüy*, in Lucas, t. ii. p. 418.

External Characters.

Its colour is liver-brown, inclining to pistachio-green.

It occurs in straight lamellar concretions, and crystallised in the following figures:

1, Regular six-sided prism, which is sometimes so short as to form a six-sided table.

2. The six-sided prism, truncated on the terminal edges.

The terminal planes of the crystals are shining and pearly; the lateral planes, when not covered with a rough dull crust, are shining and vitreous.

The most distinct cleavage is parallel with the terminal plane of the prism; another less distinct parallel with the plane

lateral planes of the prism. The fracture is uneven, passing into splintery.

Internally the lustre of the cleavage is shining and pearly; the fracture is glimmering.

It is translucent on the edges.

It is semi-hard.

Its streak is brownish-white.

It is brittle.

Specific gravity 3.081.

Chemical Characters.

It is insoluble in water. It is soluble in muriatic acid, with exception of a small siliceous residuum. Before the blowpipe, it gives out vapours of oxygenated muriatic acid *, and is converted into a magnetic oxide of iron †.

Constituent Parts.

Protoxide of Iron, -	21.810
Protoxide of Manganese,	21.140
Submuriate of Iron, -	14.095
Silica, - -	35.850
Lime, - - -	1.210
Water, and Loss, -	5.895

Hisinger.

Geognostic and Geographic Situations.

It occurs in a bed of magnetic ironstone, along with calcareous-spar and hornblende, in Bjelke's mine in Nordmark, near Philipstadt in Wermeland.

Observations.

* A small piece of this mineral will fill a whole room with the smell of oxygenated muriatic acid. Its name is borrowed from this property.

† By heating, the iron parts with a part of its oxygen to the muriatic acid, and converts it into oxygenated acid.

Observations.

It was discovered by Messrs Henry, Gahn and Clason, during a mineralogical journey through Wermeland.

30. Spinthere, *Haüy.*

External Characters.

Its colour is greenish-grey.

It occurs in small oblique double four-sided pyramids.

Its cleavage has not been ascertained.

It does not scratch glass.

Geognostic and Geographic Situations.

It occurs in the department of Isere in France, incrusting calcareous-spar crystals.

Observations.

1. It is believed to be a variety of Sphene.

2. When passed to and fro before the light of a candle, the surface becomes as it were scintillating, caused by an infinite number of brilliant reflections; whence the name of the mineral.

31. Tennantite, *Phillips.*

External Characters.

Its colour varies from lead-grey to iron-black.

It rarely occurs massive; usually crystallised in rhomboidal dodecahedrons, either perfect or variously modified

 by

by truncations on the edges; also in the form of the cube and octahedron, of which the edges and angles are truncated.

Externally the crystals are often splendent, and nearly of a tin-white colour; sometimes lead-grey with a low degree of lustre; occasionally iron-black and dull.

The cleavage is dodecahedral.

It is reddish-grey in the streak.

It is rather harder than grey-copper.

It is brittle.

Specific gravity 4.375.

Chemical Characters.

Before the blowpipe on charcoal, it first burns with a blue flame, and slight decrepitation, to which succeeds copious arsenical vapours; leaving a greyish-black scoria, which affects the magnetic needle.

Constituent Parts.

Copper, - -	45.32
Sulphur, - -	28.74
Arsenic, - -	11.84
Iron, -	9.26
Silica, - -	5.00
	100.16

Richard Phillips.

Geognostic and Geographic Situations.

It occurs in Cornwall in copper veins that intersect granite and clay-slate, associated with common copper pyrites, black copper, vitreous copper, and variegated copper. It has been met with in Dolcoath, Cook's Kitchen, and

Tincroft copper-mines near Redruth; and in Huel Virgin, Huel Jewell, and Huel Unity, near St Dri in Cornwall.

Observations.

This mineral is named in honour of that distinguished chemist the late Mr Tennant. It appears to be a variety of grey copper.

32. Woodan Pyrites.

Woodan-Kies, *Lampadius.*

External Characters.

Its colour is dark tin-white, passing into grey or into brown.

It occurs in vesicular massive portions.

Its lustre is shining or glistening, and metallic.

The fracture is fine or coarse-grained uneven.

The fragments are indeterminate angular, and rather sharp-edged.

It is opaque.

It is harder than fluor, but softer than apatite.

It is brittle, and easily frangible.

Specific gravity 5.192.

Constituent Parts.

It contains 20 *per cent.* of a new metal named Wodanium, combined with sulphur, arsenic, iron, and nickel.

Geographic Situation.

It is said to occur at Topschau in Hungary.

Observations.

The new metal, said to exist in this pyrites, was discovered by Lampadius.

33. Yttro-cerite, *Berzelius.*

External Characters.

Its colours are reddish and greyish white, and violet-blue.

It occurs massive, and in crusts.

The lustre is glistening.

It has an indistinct cleavage.

It is opaque.

It yields to the knife; scratches fluor.

Specific gravity 3.447.

Constituent Parts.

Oxide of Cerium, - -	13.15
Yttria, - - - -	14.60
Lime, - - - -	47.77
Fluoric Acid, - - -	24.45

Berzelius.

Geognostic and Geographic Situations.

It has hitherto been found only at Finbo, near Fahlun in Sweden, imbedded in quartz, or incrusting pyrophysalite.

END OF VOLUME THIRD.

INDICES.

INDICES,

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Plates V. VI. VII. and VIII. end of Volume II.

Plates IX. X. XI. and XII. end of Volume III.